Washington State Transportation Commission

Statewide Rail Capacity and System Needs Study

Task 3 – Rail Capacity Needs and Constraints

Technical Memorandum

prepared for

Washington State Transportation Commission

by

HDR, Inc.
Transit Safety Management

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Summary

There is more to reliable rail transportation network than fixing current known bottlenecks. Fixing bottlenecks increases capacity only to the degree allowed by the next greater capacity limitation. If capacity limitations are not considered carefully when developing a solution, it is possible that the only achievement will be moving a "bottleneck" rather than fixing or removing it. It is important that the root cause of the problem be carefully explored in order to avoid treating the symptom versus the cause of the congestion. The capacity limit of a yard may manifest as a problem on the main line and main line capacity limitations may manifest as congestion and delay at some distant point. It is important to understand how the rail transportation network operates in order to identify infrastructure, operational, and institutional changes required to increase the network's capacity.

Objective

This objective of this technical memorandum is to document known as well as anticipated operational and capacity constraints of the current state of freight and passenger rail systems that may adversely impact the State's economy, environment, and/or quality of life.

Using available studies, railroad reports, and public data, this interim memorandum describes how rail capacity is determined, provides an overview of current freight and passenger rail train volumes and capacities, and summarizes the ability of the network to accommodate the projected growth in rail traffic.

Funded public and private sector rail improvements, such as siding extensions by the BNSF Railway along the Columbia River, and WSDOT passenger rail projects such as the Vancouver and Point Defiance Bypass projects designed to eliminate identified bottlenecks, also are described in this memorandum.

Washington State is undertaking a statewide review of the current state of the freight and passenger rail systems. The study investigates the State's projected rail needs, the capacity of the existing rail network to meets these needs, and the State's role in identifying and facilitating needed institutional, operational, and infrastructure improvements. The technical memorandum is one of a series of technical memoranda documenting the Washington State freight- and passenger-rail systems.

Methodology

What Is Meant by Rail Capacity?

If a train leaves Chicago at 12:00 a.m. traveling west at 50 mph and a train leaves Seattle at the same time traveling east at 50 mph, where will they meet?

In the real world of railroading the answer is "It depends." What is the capacity of Washington's railroad network? It depends on a complex set of interrelated factors that are described in the following sections.

Rail capacity is the number of trains that can occupy a given segment of track over a given period of time. Determining "the number of trains" is a complex mix of science and art. In general, the science part of capacity depends upon the length and speed of the trains in addition to the characteristics of the physical railroad network. The railroad network includes main lines, sidings, terminals, rail yards, locomotive and car maintenance facilities, fueling facilities, signal systems, and communications infrastructure. All components of the network must be functioning perfectly and managed perfectly to achieve the theoretical rail capacity (the capacity limit imposed by infrastructure). When every opportunity to operate a train has been used, capacity has been reached.

The art of calculating capacity is applying factors such as human decisions, weather, equipment failures, imbalances between supply and demand for labor and equipment across the network, and other common variables during normal operation to determine the realistic versus the theoretical capacity of a given rail network. This capacity is termed the practical capacity. In general, practical capacity is approximately one-half of theoretical capacity. As much as 80 percent of theoretical capacity may be used for short durations during normal operation and retain a good quality of operation

Congestion occurs when traffic exceeds theoretical capacity (the maximum amount of traffic that the infrastructure can accommodate). It continues until sometime after traffic is less than theoretical capacity (the time needed to move the accumulated traffic at the capacity rate). For example, on a line with a theoretical capacity of 24 trains per day (one per hour), a traffic flow of greater than one train per hour for any period will exceed capacity and cause congestion as trains accumulate while waiting to be accommodated on the capacity limiting segment. The congestion will end when the rate of flow has been reduced to less than one train per hour for a sufficient time to accommodate the approaching traffic as well as the accumulated traffic. Thus, a line with a capacity of 24 trains per day can experience severe congestion and extensive delay with a daily volume of eight trains per day. Congestion should not occur when traffic falls within the practical capacity range, but this is dependent upon operating practices as well as capacity.

How Is Rail Capacity Determined?

Main Line Capacity

Main line capacity is calculated using a two-step process. The theoretical capacity of the line is calculated based on a set of perfect assumptions and conditions. This represents the maximum density of trains that can operate over a given section of track at the highest speeds authorized for those trains.

The density or spacing of trains moving in the same direction is an important element of capacity on double track (each track generally assigned to a single direction of movement). Current rail signaling systems divide the track into sections or "blocks." Only one train can occupy a block of track at a time. Signals at the ends of the block tell the locomotive engineer if he can proceed into the next block. This is necessary because the stopping distance of a train greatly exceeds the sight distance of the locomotive engineer controlling it. Signal spacing defines the track occupancy because the train virtually occupies the block in front of it. The minimum distance between signals is equal to the length of the longest train plus the required stopping distance for the heaviest train at the highest authorized speed, plus a margin of safety. If the signals are spaced five miles apart, the maximum theoretical density is one train every five miles. The speed of the train and the spacing of the signals determine the minimum headway between trains that are moving at the normal speed for trains on the line. The minimum headway determines the theoretical capacity of the line.

Minimum headway traffic is similar to traffic on a freeway where all the vehicles are traveling at 70 mph and are spaced at exactly the safe following distance apart. In reality a freeway may actually operate like this for a very short period of time over a very short distance before something happens that impacts this perfect distribution of speed and density. The system then breaks down and a traffic jam forms.

Practical capacity is the percentage of theoretical capacity that provides reliable and predictable train operations. Generally, the rail industry considers this to be between 50 and 60 percent of the theoretical capacity. On rail lines operating at practical capacity, minor disruptions can be absorbed with only temporary localized deterioration in performance. The overall rail network will continue to function in a predictable and reliable manner. This is similar to a freeway operating at a level of service of C.

The system can continue to operate at levels up to 80 percent of the theoretical capacity, but any minor disruptions will result in severe disruptions to train operations systemwide. Operations over 80 percent of the theoretical capacity are not considered achievable except for very short segments over short periods.

Yards and Terminals

Rail yards and terminals serve as reservoirs for the main lines, absorbing and redistributing railcars to their final destinations. A terminal is a geographically defined area that may consist of one or more yards. The capacity of the terminal is generally an aggregate of the capacity of the yards it encompasses. There are two aspects to the capacity of a terminal or yard: static and dynamic capacity.

Static capacity is the ability of a yard to accommodate standing equipment, i.e., cars that are stored, awaiting movement, or awaiting processing. It is related only to infrastructure. Static capacity is a simple measurement of the length of railroad cars against the trackage available for them. The static capacity may be broken into categories if portions of the yard trackage are designed for or assigned to a specific purpose. For example, if certain tracks are assigned to storage, classification, arriving trains, departing trains, repair, or trains that are stopping to set out or pick up, each has a separate capacity. These separate capacities form an aggregate capacity; however, the number of cars in each category cannot be exceeded regardless of the aggregate capacity and number of cars. The practical static capacity of a yard is considered to be between 60 and 80 percent of the theoretical static capacity. A yard must always have some open tracks available to receive, process, and dispatch cars.

Dynamic capacity is the ability of a yard to receive, process, and dispatch traffic, generally described in trains per hour for receiving and dispatching and cars per hour for switching. Static capacity is indirectly related to dynamic capacity. If traffic exceeds dynamic capacity, the number of cars in the yard may exceed static capacity. Dynamic capacity is dependent upon infrastructure, personnel, and equipment.

Classification yards have a special capacity limitation, the number of classifications into which cars must be sorted. For example, if a classification yard has five tracks, each with a capacity of 50 cars, the capacity is 50 cars for each of five destinations, not 250 cars. It is possible for six cars to exceed the capacity of the five tracks if each of the six has a separate destination (although this may be mitigated by the practice of double blocking, i.e., putting cars for more than one destination into each track and switching them again after the cars in one or more tracks have been removed from the classification yard for further movement on trains).

Intermodal yards also may have a pavement capacity limitation, i.e., a limitation imposed by the pavement surface area available on which to drive vehicles, load or unload rail cars, or store trailers and containers.

What Factors Have the Greatest Effect on Rail Capacity?

Main Line Infrastructure

The limitation of capacity on a single track section of a railroad is the longest running time between sidings (or other tracks on which trains in opposite directions can meet). It may be further affected if there also is a need for a faster moving train to pass a slower train on the same section of railroad. As siding spacing is decreased and/or speed increases, capacity increases.

On a multiple track railroad, the limitation on capacity is the longest time that a train occupies a block. As signal block spacing decreases capacity increases.

Yard Infrastructure

The number of operations that can occur simultaneously within a yard is directly related to the rail capacity of the yard and the main lines to which it is connected. For example, if switching must stop while a train is arriving or leaving a yard, those activities are limited by infrastructure. If the yard capacity to arrive and depart trains is less than the main line capacity then it may not be possible to fully utilize all of the main line capacity.

Speed

The capacity of a single track line can be increased by increasing the speed, both in main track operation and in entry and exit of sidings. An increase in speed on a multiple track line can increase capacity; however, it must be accompanied by a signal system design that will allow the increase to be utilized for additional capacity.

Signals

If there is a great speed differential among trains, signal system design can affect capacity. On a line that has heavy bulk commodity trains operating at 45 mph, light intermodal trains at 60 mph, and passenger trains at 79 mph, a signal system designed only for the stopping distance of the bulk commodity trains may unnecessarily increase the headways between trains. Signal system design can incorporate the differences in a number of (albeit more complex) ways. For example, instead of a series of three signals, the first indicating stop, the second indicating reduce speed and prepare to stop at the next signal, and the third indicating proceed at normal speed, the series might be more closely spaced signals indicating stop, proceed at 30 mph, proceed at 45 mph, proceed at 60 mph, proceed at normal speed.

The compensation for variation of speed limit is only effective when the speed limit affects all traffic. When the speed differential involves trains entering or leaving a route at a speed substantially less then the speed of through traffic, the speed differential cannot be compensated. In these situations, speed differential results in capacity loss.

Personnel

Insufficient personnel can affect dynamic yard capacity. For example, if a yard has several receiving tracks, one team of car inspectors, and the ability to switch inspected inbound trains faster than they can be inspected, the capacity is limited by the lack of car inspectors.

Equipment

Equipment affects dynamic yard capacity when there is sufficient infrastructure to support simultaneous activities, but insufficient equipment. If the design of the yard permits two engines to switch cars simultaneously, but only one engine is available, the capacity is limited by equipment. This limitation also extends to the operation of trains between terminals. If the cars are available, made up, and ready to leave as a train, but there are no locomotives available, capacity is limited by equipment.

Traffic Demand

Traffic demand requirements are a nontechnical aspect of capacity. When capacity is described in terms of trains per day, the figure may include periods during which there is little traffic demand. A line with a capacity of 50 trains per day may be inadequate for commuter operations if the capacity available for commuter trains is at 3:00 a.m. Similarly capacity is of little value to a priority intermodal train that must leave at 3:00 p.m. to reach Chicago before the close of business four days later.

Track Maintenance

Track and signal maintenance also are a consumer of railroad capacity. If track and signals are not adequately maintained, speed restrictions may be imposed, diminishing capacity. When track or signal maintenance requires exclusive occupancy of a section of track, the capacity of the track is zero. To some extent, track maintenance can occur during the difference in time between theoretical capacity and practical capacity. When this is not possible, the track is assigned exclusively to maintenance personnel during a period known as a "work window."

Grade Crossings

Road crossings at-grade can have an effect on capacity by limiting the ability of trains to stop at key locations. For example, at Tokio on the Pasco-Spokane route, the siding can accommodate a train 8,100 feet long, but Klein Road crosses the tracks 3,802 feet from the east end of the siding. Thus, a train cannot stop and wait for a passing train legally for more than 10 minutes (or less if so directed by law enforcement or emergency services personnel, WAC 480-62-220).

How Was Rail Capacity Measured for This Study?

Capacity may be measured by analytical methods (hand calculation) or by simulation modeling and analysis of the output data. The capacity of a complex arrangement of rail lines and terminals is difficult to calculate, requiring careful dissection of the subject rail line and terminals into segments of similar capacity.

Simulation models may be used for capacity evaluation; however, evaluation of simulation input/output requires careful consideration. If trains are randomly added to a rail line without considering the limitations of the infrastructure, the travel time and delay may vary radically without a physical change in the infrastructure. Analysis of the simulation output requires the same careful attention. The output needs to be evaluated that the proposed train routing and schedules are reasonable given the capacity factors of the line.

Detailed rail simulation modeling is not within the scope of this study. The capacity numbers presented herein were compiled from previous studies and other readily available information, some simple calculation, and discussion with railroad operating personnel. The study team attempted to resolve discrepancies between conflicting capacity levels, where possible, using standard analytical methods.

Current typical running times (and/or roughly calculated running times) were used for determining corridor capacity based on continuous flow (east-west-east-west) on single track lines. Train volumes are expressed as the practical capacity of the line, which is defined as, in general, 50 percent of theoretical capacity.

In order to establish a uniform basis for comparison, the discussion of practical capacity of the network does not include the effects of overtaking, which can vary widely depending upon the number of overtakes and the way in which the traffic is managed. In general, however, overtaking consumes some of the capacity described for each of the primary routes. For a short duration, as much of 80 percent of theoretical capacity may be used while maintaining an acceptable quality of operation. Thus, with adequate planning, an aggregate utilization of approximately 57 percent may still produce acceptable results.

In some cases, the typical daily train volumes exceed the practical capacity. As a result, trains operating over these track segments experience a relatively high amount of congestion and delay.

■ Existing Rail Capacity and Constraints

What Are the State's Rail Lines Capacities and What Limits Their Capacity?

The theoretical and practical capacities of Washington State's rail network were calculated based on known running times or on calculated run times between sidings and/or terminal points when known run times where not available. On double track routes, the running times and associated speeds were compared with block signal spacing. The State's major rail lines were divided into geographical corridors. See Figure 3.1, Washington State Rail System Capacity and Current Traffic Demand. The practical capacity and known constrains for each corridor are described in the following sections. As described above, the discussed capacity does not consider the additional capacity consumed by overtaking. Overtaking can involve two passenger trains, a passenger train and a freight train, or two freight trains. The capacity consumed is situational, depending upon the number of trains of each speed and the order in which they are operated. Thus, there is no basis for general comparison or discussion. However, the capacity consumed in a limited amount of overtaking may be included in the short duration periods of capacity allocation that exceeds 50 percent. See Figure 3.2, Washington State Rail System Identified Bottlenecks.

Figure 3.1 Washington State Rail System Capacity and Current Traffic Demand

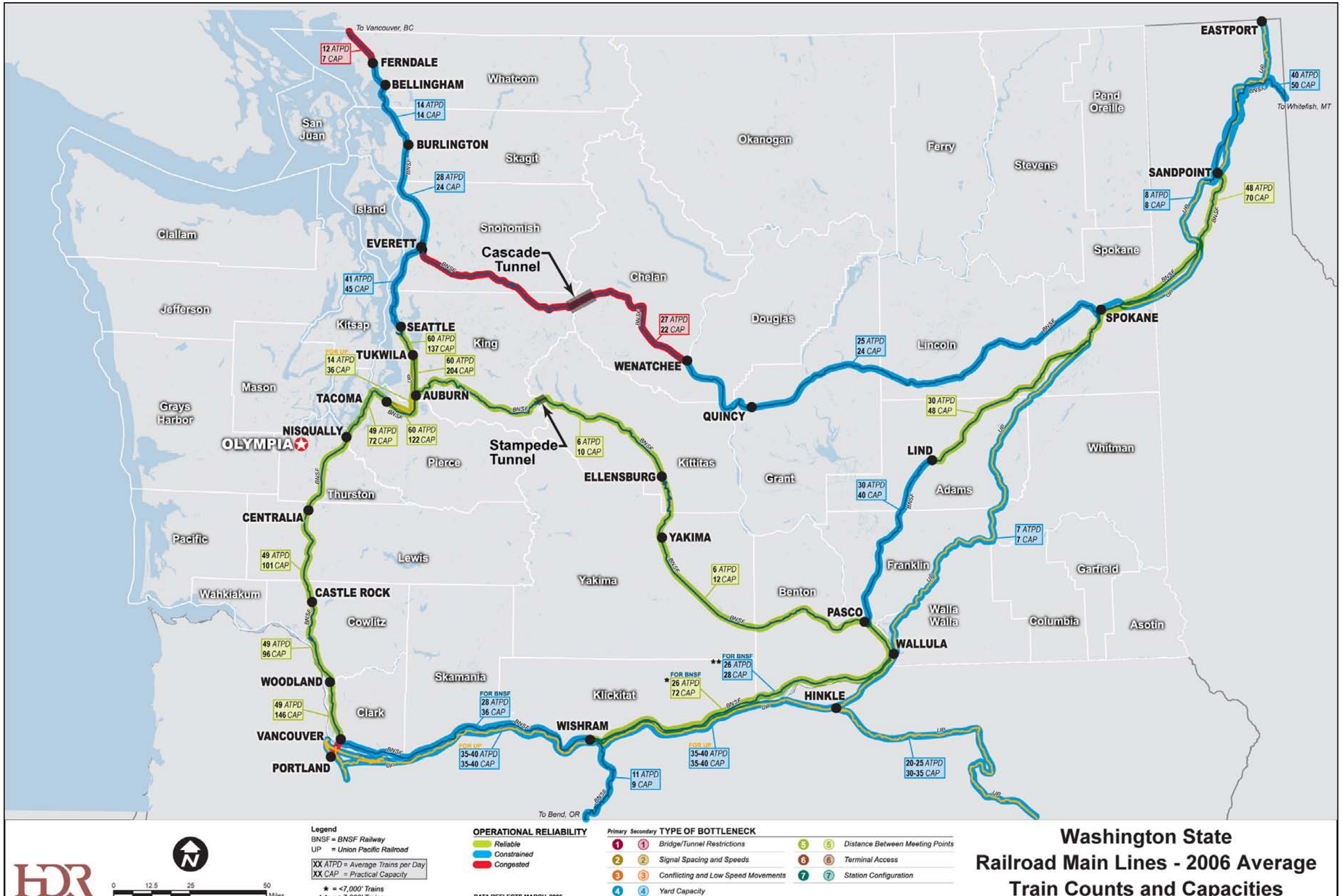
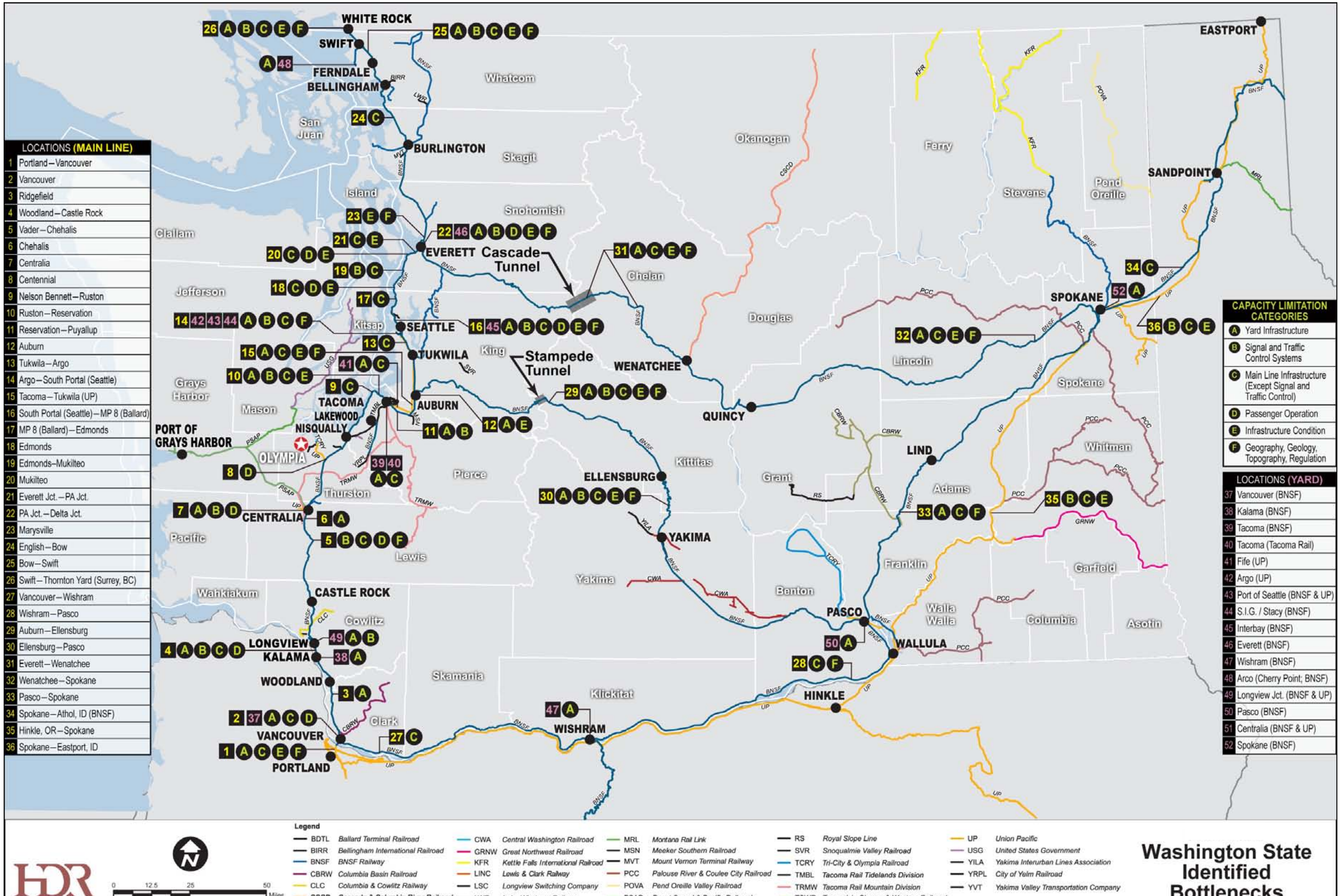


Figure 3.2 Washington State Rail System Identified Bottlenecks



Portland, Oregon-Vancouver, Washington

Rail capacity between Portland, Oregon, and Vancouver, Washington, is estimated at 84 trains per day (TPD). Three types of capacity restrictions are present within this segment (see Figure 3.2, Location 1).

1. Low-Speed Operation:
   - 10 mph operations at Vancouver Junction and North Portland Junction;
   - 6 mph over the Steel Bridge in Portland and for about 2,000 feet north of the Steel Bridge; and
   - 10 mph speed restrictions accessing Lake Yard.
2. Trains Stopped on Main Tracks:

   Several freight trains per day stop on a main track at Lake Yard, Willbridge, and North Portland Junction while setting out and picking up. Each of the stopped trains occupies the same capacity as three or more through trains.
3. Drawbridges:

   The Willamette River and Columbia River drawbridges (the Oregon Slough bridge is open for marine navigation infrequently) are open for an aggregate duration equivalent to about 24 trains per day.

Vancouver-Seattle, Washington

The capacity of the Vancouver-Seattle route is limited to 72 TPD as the result of single track railroad at the Nelson Bennett and Ruston Tunnels (see Figure 3.2, Location 9). However, individual segments of the route have greater practical capacities:

- Vancouver-Woodland 146 TPD, limited by block signal spacing and train speed;
- Woodland-Castle Rock 96 TPD, limited by extended periods of single track operation from freight rains occupying a main track while setting out or picking up at Rocky Point, Longview, and Kalama terminals;
- Castle Rock-Nisqually 101 TPD, limited by block signal spacing and train speed;
- Tacoma-Auburn 122 TPD, limited by block signal spacing and train speed;
- Auburn-Tukwila 204 TPD, limited by block signal spacing and train speed; and
- Tukwila-Seattle 137 TPD, limited by block signal spacing, speed and Union Pacific Van Asselt and Manar Yards, located on the opposite side of the BNSF main tracks from the Argo Intermodal Yard.

The major capacity limitations in each of the identified segments are summarized below. Refer to Appendix A: Summary of Identified Capacity Constraints for a more detailed description.

Vancouver-Woodland

There is an array of significant capacity limitations at Vancouver (see Figure 3.2, Locations 2 and 37), including:

- Low-speed train operations (10 mph) through Vancouver Junction can block the Portland-Seattle main tracks for extended periods as trains enter or exit Fallbridge Subdivision (Vancouver-Pasco) or cross the main tracks to access the Port of Vancouver from the Fallbridge Subdivision.

- Trains stopping on the main tracks to change train crews.

- Short yard tracks require trains originating from Vancouver Yard to occupy one of the Portland-Seattle main tracks for extended periods while crews assemble a full train for departure. Through trains also must occupy a main track set out or pick up cars at Vancouver Yard because of short yard tracks.

Woodland-Castle Rock

A significant amount of the capacity between Woodland and MP 85 (near Castle Rock) is consumed by standing trains. The occurrence is so common in this area that it is the only segment in the State for which standing traffic has been considered in calculating capacity. Some of the service at Kalama and most of the service at Longview Junction is provided by through trains that must stop on one of the main tracks while setting out or picking up cars. Trains servicing the two grain terminals at Kalama occupy a main track for extended periods due to 10 mph speed restriction accessing yard tracks and the time required to hand throw switches. (See Figure 3.2, Locations 3, 4 and 38.)

Castle Rock-Nisqually

Identified capacity restrictions in this segment include:

- Napavine Hill between Vader and Chehalis. This is the ruling (maximum) grade for freight trains between Portland and Seattle. Trains slow to speeds between 15 and 30 mph as they ascend the grade. (See Figure 3.2, Location 5.)

- Centralia congestion caused by increases in bulk commodity shipments by the Ports of Grays Harbor and Centralia. Unit trains accessing the main track at Centralia are restricted to 10 mph. In addition to increased unit train service to the Ports, several trains per day stop at Centralia, occupying a main track to set out or pick up cars. Amtrak's Centralia Station also serves as a crew change point for freight trains. (See Figure 3.2, Locations 6 and 7.)

- North of Centralia Yard, there is a junction with a line leading east to a coal-fired power plant. Recent construction of a loop unloading track at the power plant has eliminated the need for unit coal trains to occupy the main line when serving the plant. However, capacity is still partially constrained by 10 mph operations through the hand thrown switch off the main track. (See Figure 3.2, Location 7.)

Nisqually-Tacoma

In the early 1990s, BN converted the Ruston and Nelson Bennett Tunnels to single track to accommodate double-stack intermodal trains. (See Figure 3.2, Location 9.) This single track section limits capacity on the entire corridor to 72 trains per day. Freight speeds through this track section can be increased from 40 to 50 mph, increasing capacity by about four trains per day. Currently, 10 Amtrak passenger trains use the line daily. These trains could be routed onto Sound Transit's Lakeview Line. After improvements to the Sound Transit Lakeview line the combined capacity of the lines could be increased to over 135 trains per day.

Tacoma-Auburn

Trains accessing the BNSF's Tacoma Yard at the south end are restricted to 10 mph around the Thea Foss Curve. Trains entering and leaving the north end of the yard also are restricted to 10 mph. Trains that originate or terminate in Tacoma, including those bound directly to the Port of Tacoma must double into the Tacoma or Log Yard tracks, occupying one or both main tracks for an extended period and restricting through train operations to a single main track. (See Figure 3.2, Locations 10, 11, 39, and 40.)

Auburn Yard and the connection to the Auburn-Pasco line are both located on the east side of the line. Port of Tacoma intermodal trains using the yard must cross from east to west to access the yard. Trains are restricted to 10 mph when entering or leaving Auburn yard or the Auburn-Pasco route from the north (Seattle). (See Figure 3.2, Location 12.)

Auburn-Tukwila

A recent Sound Transit infrastructure project has eliminated most of the route conflicts and speed differential conflicts between Auburn and Tukwila.

Tukwila-Seattle

A recent Sound Transit infrastructure project has eliminated most of the route conflicts and speed differential conflicts between Tukwila and Argo; however, some capacity limiting conflicts remain. (See Figure 3.2, Locations 13, 14, 42, 44, and 45.)

There are three tracks between the Tukwila and Argo control points; however, only two trains may operate simultaneously through either control point. Trains to and from South Seattle Yard and UP Argo Yard enter and leave the west main track at 10 mph. Two main tracks remain for through movement, but at Argo and at Tukwila, the two through tracks cannot be used simultaneously.

Union Pacific trains must cross the BNSF main tracks when switching cars between Union Pacific's Argo and Van Asselt yards. The Van Asselt yard provides staging support for Union Pacific's Argo intermodal operations. These crossing movements are made at 10 mph. Each crossing move consumes the capacity of at least two through trains. At Rhodes or Tukwila, UP trains en route to or from Van Asselt/Manar yards must cross over the BNSF main lines to access Black River Junction, consuming the capacity of at least two trains on the Portland-Seattle route.

Tacoma-Tukwila, Washington (UPRR)

The capacity of the Union Pacific Railroad's Tacoma-Tukwila route is 36 TPD, and is limited primarily by the running time between the Fife and Auburn sidings. Capacity also is restricted by trains occupying the main track doubling in and out of the yard at Fife and setting out or picking up cars at the auto unloading facility south of Kent. (See Figure 3.2, Locations 15 and 41.)

Seattle-Everett, Washington

The capacity of the Seattle-Everett route is 45 TPD. Capacity on this segment is primarily limited by 2.5 miles of the single track railroad with a 25 mph speed limit at Everett. Identified capacity restrictions in this segment include:

- South Portal-MP 8 (Ballard). The speed limit in the tunnel between South Portal and North Portal is 20 mph. There are no intermediate signals between South Portal and North Portal resulting in a signal block length of about 1.6 miles. Additional capacity is required in this segment for non-train movements (e.g., transfers, locomotive movements) between Interbay Yard and Seattle. (See Figure 3.2, Locations 16 and 45.)

- Signal block configuration between South Portal and North Portal also imposes an additional constraint. The curvature of the track in the King Street tunnel and the combination of curvature and structures north of the tunnel limit sight distance to the degree that freight trains may need to operate at reduced speeds for the given signal indication. (See Figure 3.2, Locations 16 and 45.)

- Galer Street-MP 5.4 single track segment poses a significant capacity limitation of 48 trains per day. There is a minimum delay of 17 minutes at Galer Street when the line is operating at capacity. (See Figure 3.2, Locations 16 and 45.)

- Ballard Bridge is open for marine navigation at an aggregate of 40 trains of capacity per day. Capacity is further restricted by the 20 mph speed restriction across the bridge. (See Figure 3.2, Locations 16 and 45.)

- Edmonds single track between MP 16 and MP 18 has capacity (144 TPD) greater than the line in general; however, because of the configuration of the single track segments, a minimum delay of three minutes will occur at Edmonds when the line is operating at capacity. (See Figure 3.2, Location 18.)

- Maintenance Access Interbay-Everett Junction. This segment of track has limited roadway access requiring maintenance of way vehicles to occupy one of the two main tracks in when performing maintenance. Because of the lack of crossovers on the double track segments, a single maintenance vehicle can occupy nine miles of track, causing single track operation for as much as 12 miles. (See Figure 3.2, Locations 17 and 19.)

- Single Track Operation Interbay-Everett Junction. Overtaking moves can be made on this segment of track. However, if overtake meets are not coordinated properly, resulting train delays may be extensive because of the extended distance (up to 12 miles) required for each overtake due to the absence of crossovers on the double track segments. (See Figure 3.2, Locations 17, 18 and 19.)

- Everett Junction-PA Junction. The 2.5 miles of single track between PA Junction and Everett Junction, and the 25 mph speed limit, restricts the capacity of the entire line to 45 TPD. (See Figure 3.2, Location 21.)

Everett, Washington-New Westminster, British Columbia

The capacity of the Everett, Washington-New Westminster, BC route is 7 TPD, and is limited by the running time between the siding at Swift and Thornton Yard and the assumption that Canada Customs will continue to stop northward trains at White Rock, British Columbia, for inspection and that U.S. customs will continue holding trains on the main track at Blaine, Washington, before allowing them to proceed at 5 mph through the VACIS (Vehicle and Cargo Inspection System) at Swift. Canadian stops on the main track at White Rock occur randomly.

BNSF has begun originating and terminating trains in the CN Thornton Yard in Surrey, BC. This operational change increases the running time between sidings to 2 hours 5 minutes. If a stop on the main track for Customs at White Rock is assumed, the practical capacity of the line is reduced to 5.8 TPD.

Individual segments of the route have greater practical capacities:

- Between Everett (PA Junction) and Burlington, the capacity is 24 TPD, and is limited by the running time from Delta Junction (including 10 mph operation into and out of Delta Yard) to English siding.

- Between Burlington and Ferndale, capacity is limited to 14.4 TPD by the running time between the Bow and Ferndale sidings. The intervening South Bellingham siding does not accommodate the typical train length on the line.

The major capacity restraints in each of the identified segments are summarized below. Refer to Appendix A: Summary of Identified Capacity Constraints for a more detailed description.

Everett-Burlington

Identified capacity restrictions in this segment include:

- PA Junction-Delta Junction. The line has a capacity of 24 TPD because of low-speed (15 to 25 mph) operations over 3.8 miles of single track. (See Figure 3.2, Location 22.)

- Delta Yard. The manual hand throw switches at Delta Yard and the need to double trains together on the main line when leaving the yard further reduces capacity on this segment of track. (See Figure 3.2, Location 46.)

- Delta Junction Speed Restriction. Main line capacity north of Delta Yard is further limited by a 15 mph speed restriction around the curve at Delta Junction and a 10 mph speed restriction across Snohomish River Bridge just north of Delta Junction. The capacity on the main line through Delta Yard is limited to 14 through trains per day. The yard can originate or depart an additional 16 TPD. (See Figure 3.2, Location 46.)

- Marysville Speed Restrictions. The 20 mph speed limit for freight trains on the Steamboat Slough and Ebey Slough bridges south of Marysville limits the capacity on the line to 24 TPD. (See Figure 3.2, Location 23.)

- English-Bow capacity is limited to 16 trains per day as the result of the running time between these sidings. Capacity could be increased to 48 trains per day if the sidings at Stanwood and Mt. Vernon can be lengthened to fit longer trains. (See Figure 3.2, Location 24.)

Burlington-Ferndale

The capacity between Bow and Ferndale sidings is 14.4 trains per day. If the South Bellingham siding is lengthened to accommodate the long trains that use this line, capacity can be increased to roughly twice that number.

Ferndale-New Westminster, British Columbia

The capacity on this segment is limited by the running time between Swift and Thornton Yard and by U.S. and Canada customs procedures. The capacity is constrained by the 5 mph speed limit though the VACIS for southbound trains at Swift, the 21 mph speed limit at White Rock, and the 15 mph speed limit on the Nicomekl River bridge. (See Figure 3.2, Location 26.)

U.S. Custom inspections may affect the capacity in either direction since Swift is used as a meeting siding. Canada customs periodically stops northbound trains at White Rock for further inspection. When that occurs, capacity on the line is further reduced by the stopped train.

Vancouver, Washington-Pasco, Washington

The capacity of the Vancouver-Pasco route is limited to 36 TPD between Vancouver and Wishram. Capacity is restricted by the 20-minute running time between the end of double track at McLaughlin and the siding at Washougal, and between Bingen and North Dalles sidings. (See Figure 3.2, Location 27.)

Between Wishram and Pasco the capacity is estimated at 51 TPD if trains are restricted to 7,000 feet. If all the trains on this line are longer than 7,000 feet, then the capacity of the line is reduced to 28 TPD versus the estimated 36 TPD between Vancouver and Wishram.

Capacity is limited by the running time between Yellepit and Plymouth and between Yellepit and Hover sidings. (See Figure 3.2, Location 28.)

The capacity imitations on this line also include openings of the Columbia River drawbridge, trains from Pasco stopping en route to change crews at Vancouver Yard, and the low-speed moves to and from Vancouver Yard, the Port of Vancouver, and connection to the Portland-Seattle route.

Auburn, Washington-Pasco, Washington

The capacity of the Auburn to Pasco route is 10 TPD, limited by the running time over Stampede Pass between the sidings at Lester and Easton. (See Figure 3.2, Location 29.)

Other significant factors limiting capacity on the line include:

- Running time is between the sidings at Pomona and Ellensburg, limiting capacity to 12 TPD (See Figure 3.2, Location 30);
- Running time would be between Toppenish and Byron, limiting capacity to 17 TPD (See Figure 3.2, Location 30); and
- Form-traffic control system imposes an additional limiting human factor when the train dispatcher has to issue separate verbal/written train movement authorities to multiple trains almost simultaneously.

Everett, Washington-Spokane, Washington

The practical capacity of the Everett to Spokane route is estimated at 22 TPD and is limited by the running times between sidings over Stevens Pass between Skykomish and Leavenworth. (See Figure 3.2, Location 31.)

In balanced flow operations (east-west-east-west), the Cascade Tunnel ventilation requirements impose virtually no limitation on capacity. Sufficient ventilation for a westward train can occur between the time that the rear of an eastward train is clear of the west switch of the siding at Berne and the time that the locomotive of the westward train arrives at the east portal of the tunnel. The remaining ventilation required for the westward train, as well as the ventilation for the next eastward train, occurs while the westward train is in the tunnel. Effectively, each westward train pushes the smoke from the previous train ahead of it and pulls fresh air behind it, in conjunction with the ventilating fans. Equipment also is a limiting factor because of the severity of the grade. Running time between sidings can vary considerably depending upon the number of locomotives and their horsepower.

Capacity also can be affected by the relatively short sidings at Lyons, Espanola, and Edwall, all less than 8,000 feet long. When trains of more than 7,400 feet are considered, the capacity between Bluestem and Latah Junction is 18 trains per day. For trains of over 7,500 feet, the capacity is 138 trains per day. (See Figure 3.2, Location 32.)

Pasco, Washington-Spokane, Washington

The capacity of the Pasco-Spokane route is 40 TPD, limited by the running time between Connell and Cunningham, between Sand and Paha, and between Sprague and Fishtrap. (See Figure 3.2, Location 33.)

Spokane, Washington-Sandpoint, Idaho (BNSF)

The capacity of the Spokane-Sandpoint route is 102 TPD, limited by the running time between Rathdrum and Ramsey. (See Figure 3.2, Location 34.)

Hinkle, Oregon-Spokane, Washington (UPRR)

There are two levels of capacity on this line, dependent upon train length. For trains of up to 6,700 feet long, the capacity is 7 TPD, limited by the 1-hour 40-minute running time (55.3 miles) between the sidings at Joso and Wells. For trains over 6,700 feet long, capacity is limited to 4.6 TPD by the 2-hour 35-minute running time (89.2 miles) between the sidings at Ayer and Overlook (on BNSF). (See Figure 3.2, Location 35.)

Spokane, Washington-Sandpoint Idaho (UPRR)

Capacity between Spokane and Sandpoint is limited to 7.6 TPD based on the 47-mile distance between the BNSF connection at Napa Street in Spokane and the siding at Clagstone. This results in a 1-hour 35-minute running time for trains up to 6,400 feet long. For trains greater than 6,400 feet long, capacity is limited by the 64.7 miles between Spokane and the east end of the line at Eastport ID, which reduces the practical capacity to 5.5 TPD. Running time increases from 1-hour 35 minutes to 2 hours 10 minutes. (See Figure 3.2, Location 36.)

Primary Rail Terminals and Yards

Yard capacities are difficult to calculate and describe in simple terms because of the multitude of functions they perform. Some yards have separate assigned tracks for arriving trains, departing trains, storage, switching, and other activities. The capacity, at least the static capacity, of these yards can be described in terms of the number of cars that can be accommodated in the areas assigned to each function. The capacity of Washington State's existing rail yards were not calculated as part of this study. Yards with known capacity constraints are described in following sections of this report.

The total number of cars that can be accommodated in the yard tracks assigned to each function is important; however, the number of tracks assigned to each function and their length is equally important. For example, eight trains of 8,000-foot length can be accommodated in a receiving yard that has a 24,000-foot capacity. If the capacity consists of three tracks of 8,000-foot length, the arriving train can enter the yard and transform from a train to static cars in 10 minutes. If the capacity consists of six tracks of 4,000-foot length, the same train may spend 15 minutes transforming from train to cars. For those

15 minutes, other trains cannot use the lead track being used to double into the yard. A classification yard can have physical room for 10,000 feet of cars, but if the yard must sort cars for 15 destinations and the capacity consists of 10 tracks, each 1,000 feet long, some cars must be handled more than once because of insufficient capacity.

Some yards do not have separate tracks for the various functions. Function is assigned to tracks dynamically as deemed appropriate by the yardmaster. Determining the capacity of these yards is difficult because it can change depending upon the nature of the activities occurring in the yard.

Regardless of capacity, several characteristics of a yard can affect main line capacity. If trains must move slowly on main tracks while entering or leaving the yard, must occupy a main track while stationary (e.g., setting out, picking up, doubling), or cannot be accommodated in the yard on arrival, they will diminish main line capacity. For example, if each of two main tracks passing a yard can accommodate a train every 10 minutes (theoretical capacity 288 trains/practical capacity 144 trains), a train that cannot enter the yard for 20 minutes on arrival occupies the capacity of two trains. In the same situation, a train that must occupy a main track for 30 minutes while doubling occupies the capacity of three trains. If the doubling train must occupy both main tracks (e.g., to leave on the main track farthest from the yard), it occupies the capacity of six trains. If 10 trains per day double out of the yard, they occupy the capacity of 30 to 60 trains. A train that does not block a main track while doubling but enters or leaves the 30-50 mph main track at 10 mph will often occupy the main track capacity of at least two trains.

When a train that is arriving or leaving blocks switching, the capacity of the yard may be diminished because the time available for processing is reduced. For example, if a train arriving or leaving interrupts switching for 20 minutes, the time available for switching is diminished by as much as 1 percent (20 minutes from a day of 7 hours switching time). Yardmasters can limit the reduction in productivity by assigning other work (coupling already switched cars, spotting the repair track), but a large number of arriving and leaving trains interrupting switching can make a significant reduction in dynamic capacity.

To some extent, the capacity reduction imposed by yard configuration can be limited by operating practices (careful scheduling to avoid conflicts), but as traffic increases, that strategy becomes increasingly impractical.

Since the mid-1990s, simulation studies have demonstrated that yards reach their physical limit of ability to accommodate traffic before main lines with proposed improvements do (e.g., the Sound Transit and WSDOT programs). Main line operation then breaks down as a result of trains that cannot be accommodated in yards parking on main tracks.

Table 3.1 describes yard characteristics that affect the extent to which yard and/or main line capacity can be used.

Table 3.1 Washington State Rail System Capacity and Current Traffic Demand

Yard	Dedicated Receiving/ Departure Tracks	Receiving/Departure Min/Max Length	Classification Tracks	Classification Tracks Min/Max Length	Simultaneous Receiving/Departure	Simultaneous Switching/ Receiving or Departure	Doubling Blocks/ Limits Switching	Doubling Blocks/Limits Receiving/Departure	Doubling Blocks Main Track	Through Setout/ Pickup Blocks Main Track at Yard	Through Setout/Pickup Blocks Main Track Approaching Yard	Through Setout/Pickup/ Limits/Blocks Switching	Switching Occasionally Blocks Main Tracks
Delta (BNSF Everett)	No	3565-3565	14	1470-3600	No	No	Blocks	Blocks	Yes				Yes
Interbay (BNSF Seattle)	2	5600-8000	35	600-3600	No	Limited	Limits	Blocks	North Yes South No	Occasionally	Yes	Occasionally	Yes
Stacy/SIG (BNSF Seattle)	R-Yes 3 south of Argo D-No	R 10500 D 4000	19	900-4050	Yes	Limited	Limits	Blocks Departure	No				No
Terminal 5 (Port of Seattle)	No	5000			No	No	Blocks	Blocks	No				No
Argo (UP Seattle)	No	3000			No	No	Blocks	Blocks	Yes			Trains to and From Terminal 5 block receiving, departure, and switching	Yes
South Seattle (BNSF Seattle)	4	4300-8650	3	3500-3800	No	No	Blocks	Blocks	No				No
Tacoma (BNSF)	No	1075-3600	32	1075-3600	No	No	Blocks	Blocks	Yes	Yes	Yes	Yes	Yes
Tacoma (Tacoma Rail)	2	7500			No	Yes	No	No	No				No
Fife (UP)	No	4000			No	No	No	Yes	Yes	Yes	Yes	Occasionally	No
Longview Jct. (BNSF/UP Longview)	No	3600	12	3600	No	Limited	Limits	Blocks	Occasionally	Yes	Yes	Limited Switching	No
Vancouver (BNSF)	2	3900-5740	29	775-4800	No	Yes	No	Blocks	Yes	Yes	Yes	Occasionally	Yes
Pasco (BNSF)	11	7300-8500	47	890-1600	Yes	Yes	No	No	No				No
Yardley (BNSF Spokane)	5	7100-8600	33	800-4800	Limited	Limited	Limits	Limits	Occasionally	No	Occasionally	Occasionally	No

Terminals and yards are only part of the rail network. When key terminals and yards exceed theoretical capacity the railroads can manage those locations by keeping the network fluid. The two primary measures used to monitor yard fluidity are "cars-in-inventory" and "dwell time." As cars-in-inventory increases so does dwell time. Using these and other train forecasts railroads determine the nature of operations one week into the future based on current operating conditions. BNSF has identified the "performance degradation point cars in inventory" for each primary terminal on their network. With the goal of keeping the network fluid railroads will execute actions such as alternate routes and handling train traffic differently to alleviate pressure. Some bottlenecks are addressed by changing how trains are blocked switched, including doing some switching on line and in sidings to relieve congestion.

Table 3.2 shows the terminal performance for major BNSF terminals in Washington State.

Table 3.2 Terminal Performance for Major BNSF Washington State Terminals

Yard	Daily Average	28-Day High	Performance Degradation Point	Percent of Performance Degradation Point
Wishram	103	184	125	82%
Kalama	31	54	100	31%
Longview Junction	184	210	200	92%
Pasco	1,686	2,004	1,700	99%
Kent	37	96	60	62%
Pasco-Ain Junction	1,873	2,171	1,700	110%
Seattle	123	160	150	82%
Spokane	589	762	700	84%
Tacoma	204	250	200	102%
Vancouver	456	610	475	96%
Wenatchee	27	57	60	45%
Yakima	79	117	125	63%
Arco	80	115	80	100%
Bellingham	46	65	80	58%
Centralia	107	154	125	86%
Connell	8	21	30	27%
Everett	521	671	500	104%
Interbay	403	492	325	124%

The primary rail terminals in Washington are BNSF's Spokane, Pasco, Vancouver, Seattle, and Delta (Everett) Yards, the UPRR's Argo Yard (Seattle), and Tacoma Rail's Tacoma Yard.

Spokane-BNSF

Spokane Yard is a flat switching yard responsible for classifying cars for trains going east, west, and south, as well as various locals. The average daily capacity is 1,000 to 1,200 cars, with an average dwell of 27 hours. The terminal is considered critical when it exceeds 1,300 cars. The yard consists of three main yards: Erie Street; Hauser, Idaho; and Yardley. Erie Street Yard is used primarily for grain trains or UPRR interchange. Hauser Yard is used primarily for limited intermodal pick-up/set out, grain storage, 1,000-mile inspection, adding distributed power, and crew changes. Yardley Yard is split between two smaller yards. The "hell hole" is made up of 17 short tracks where most of the small blocks are built. The larger yard is located next to the mainline and used for larger blocks and for setting out, picking up, and building trains. When the yard is full the mainline is used for building outbound trains. Picking up blocks for outbound trains usually requires the train be entirely reswitched when it contains multiple blocks. This reswitching can take as long as five hours to complete. Since this is not primarily an origin/destination point the biggest constraint to maintaining a fluid yard is having inbound trains and power arrive on time. Also, due to the fact that the crew change point for the trains through Spokane is at Hauser, Idaho, 24 miles away, the mainline capacity between Spokane and Hauser is critical. Mainline capacity between Spokane and Athol was identified as being critical to Spokane Yard. Currently, approximately half of the 42 miles is double track and half single track.

The performance degradation point for Spokane Yard is 700 cars in inventory. Cars-in-inventory between April 15, 2005, and April 15, 2006, was:

- Daily Average = 589;
- Highest 28-Day Period = 762;
- Highest 7-Day Period = 867; and
- Single-Day Maximum = 1,006.

Pasco-BNSF

Pasco Yard is a directional hump yard responsible for classifying 41 blocks, arriving 15 trains per day, and departing 14 trains per day. The yard includes 47 bowl tracks, 9 arrival tracks, and 10 departure tracks. The biggest issue with the yard capacity is on-time trains and power.

The performance degradation point for Pasco Yard is 1,700 cars in inventory. Cars-in-inventory between April 15, 2005, and April 15, 2006, was:

- Daily Average = 1,686;
- Highest 28-Day Period = 2,004;

- Highest 7-Day Period = 2,178; and
- Single-Day Maximum = 2,352.

Vancouver-BNSF

Vancouver Yard is a flat switching yard responsible for classifying cars to/from Pasco, California, UPRR, Interbay, Everett, and various locals. The average dwell is 24 hours, which is consistent with only having a single outbound train for a block (destination). The dwell time increases quickly when the daily yard inventory exceeds 750 cars. Yard operations conflict with other mainline operations and further impacted by existing infrastructure constraints. Mainline operations through Vancouver Yard total 70 to 75 trains per day. These trains include general merchandise, intermodal, unit trains (grain), UPRR interchange, and Amtrak. Flat switching is done from both ends of the yard with a restriction of 12 cars at the south end because of the mainline operations. Yard operations conflict with other mainline operations and further impacted by existing infrastructure constraints. The primary infrastructure constraint is the 10 mph single mainline track connecting the Fallbridge and Seattle Subdivisions. This configuration reduces the mainline throughput and because of the yard, lead, and mainline conflicts consumes mainline capacity whenever departing trains from the Yard or United Grain. The time-sensitive schedule for Amtrak also causes certain yard operations to stop throughout the day for Amtrak trains.

The performance degradation point for Vancouver Yard is 475 cars-in-inventory. Cars-in-inventory between April 15, 2005, and April 15, 2006, was:

- Daily Average = 456;
- Highest 28-Day Period = 610;
- Highest 7-Day Period = 701; and
- Single-Day Maximum = 896.

Seattle-BNSF

Seattle Terminal is made up of the following yards in the Seattle area:

- Two main yards:
  - Interbay/Balmer; and
  - Stacy Street.
- Support yards:
  - West Seattle;
  - South Seattle; and
  - Kent.

Interbay/Balmer has an old and inefficient mini-hump, so the yard effectively flat-switches to classify cars for trains going north and south. Interbay also supports an adjacent grain elevator in the area.

Stacy Street is located east of the Seattle International Gateway (SIG) international intermodal facility. Stacy Street supports SIG and several local general merchandise customers.

West Seattle does not arrive or depart any trains but does support Port of Seattle T-5 intermodal and serves local industries in West Seattle and Harbor Island.

South Seattle supports the South Seattle Domestic Intermodal facility and a couple of general merchandise customers.

Kent does not classify cars but does support general merchandise customers in the Kent Valley and the facility. Primarily a setout and pick up location.

The biggest issue with the yard capacity is not being able to depart trains. The reasons for not being able to depart trains is usually lack of power or crews. Commuter windows do restrict when trains can arrive and depart.

The performance degradation point for Interbay Yard is 325 cars in inventory. Cars-in-inventory between April 15, 2005, and April 15, 2006, was:

- Daily Average = 403;
- Highest 28-Day Period = 492;
- Highest 7-Day Period = 584; and
- Single-Day Maximum = 662.

Delta (Everett)-BNSF

Delta Yard is a flat switching yard responsible for classifying cars for 12 outbound trains as well as various locals. The average daily capacity is 800 cars with an average dwell of 28 to 29 hours. The terminal is considered critical when it exceeds 850 cars. The yard is a belt pack operation which limits the cuts of cars to be switched to 15 cars. The yard is made up 13 tracks, which are used for classification and receiving/departing. The biggest issue at Delta Yard is the downtime for passenger train (Sound Transit and Amtrak) windows. Also, having six 7,000-foot R&D tracks and 14 additional classification tracks would provide additional future capacity and fluidity. The WSDOT High-Speed Rail Corridor project, which realigns Rogers Main to connect with the Bayside Subdivision, would reduce conflict with through trains waiting for commuter windows and a slot through the Everett tunnel.

The performance degradation point for Delta Yard is 500 cars in inventory. Cars-in-inventory between April 15, 2005, and April 15, 2006, was:

- Daily Average = 521;
- Highest 28-Day Period = 671;
- Highest 7-Day Period = 712; and
- Single-Day Maximum = 836.

Argo-UPRR

Union Pacific Railroad's (UPRR) Seattle operation is Argo Yard, located south of the downtown area. Argo Yard is bound by East Marginal Way to the west, various industrial sites to the south, Spokane Street to the north, and BNSF mainline to the east. The facility handles domestic intermodal trailers and containers, solid waste containers, solid waste transfer facility, as well as Port generated containers. The storage and interchange tracks located on the north side the yard are used for both intermodal and carload operations for both UPRR and BNSF.

UPRR switch crews currently move cars between businesses on Harbor Island and Argo Yard. Most UPRR trains are arrived and departed from Argo Yard. UPRR unit trains currently going to Harbor Island Terminal 5 must pull through Argo Yard which interferes with Argo Yard. According to UPRR officials, UPRR operates 24/7 in terms of intermodal container handling capability.

The facility has loading tracks for domestic and marine containers, and a separate loading area for the solid waste containers at the south end of the yard. Combined, all loading tracks have a capacity of 67 five-platform DST rail cars each 305 feet in length.

Tacoma Yard-Tacoma Rail

Tacoma Rail's primary responsibilities are to support Port of Tacoma intermodal operations and local Commercial customers. The goal is to maintain a continuous flow of rail traffic without disruption. This is accomplished by first being able to receive inbound trains from either of the mainline carriers (UP, BNSF) that serve the Tideflats as they arrive in the Tacoma area. Second, Tacoma Rail yards must have enough room to switch out, stage, and position railcars for efficient delivery. Third, Tacoma Rail's staging and support infrastructure must have sufficient room to pull completed trains or empties from its customers.

Tacoma Rail uses a rail industry rule of thumb for infrastructure utilization that available track should not be utilized in excess of 60 percent by railcars. Utilization in the range of 50 to 60 percent indicates mild congestion. At that level, there are some restrictions of operations. Ratios in excess of 60 percent indicate significant congestion and reduced responsiveness. At a time of significant utilization, railcars have to be moved and shuffled excessively to make room for other cars while attempting to keep cars in logical sequences. Utilization in excess of 80 percent indicates a yard is in gridlock and all activities are severely delayed.

See terminal working inventory graphs in Appendix A.

Secondary Rail Corridors

The secondary rail corridors in Washington State are generally not constrained by train volumes. Usually one train per day in each direction is sufficient to handle the car volumes generated by the line. The capacity constraints are directly related to the track condition and the resulting speed restrictions to the service. For example, Tacoma Rail operates freight service (under franchise agreement with BNSF) on the Nisqually to Tacoma line that Sound Transit purchased from BNSF. Speeds are restricted to 10 mph because of track condition. A single round-trip on this 16-mile line takes almost four hours. Tacoma Rail uses two shifts of train crews to serve a modest number of freight customers on the line. Funded Sounder and Amtrak *Cascades* track and signal improvements on this line will reduce the freight round trip time from 4 hours to 50 minutes. The freight service currently provided by two crews will be performed by one crew with time left for other work.

The effect of low speeds on longer secondary lines can be even more significant. A train on an 80-mile secondary line of with a speed limit of 20 mph will spend an entire workday merely traveling from one end of the line to the other and back again. The economies of rail transportation (reduced fuel, labor, and equipment cost) are lost to increased travel time.

What Are the Commuter and Intercity Passenger-Only Constraints?

Capacity limitations for passenger trains operating between Portland, Oregon, Seattle, Washington, and Vancouver, British Columbia, result from a combination of infrastructure designed exclusively for freight operations and by the time-sensitive nature of passenger service. The time-sensitive requirements for passenger service can amplify the effect of relatively small capacity limitations. This effect is not limited to passenger trains, however. It also is associated with the operation of domestic intermodal trains.

A small amount of delay is generally not important to freight traffic, but passenger service requires a strict adherence to schedules developed with the fastest possible running times to attract and maintain riders. Passenger train operation must be precisely planned over the entire route to avoid delays. In general, a passenger train occupies less capacity than a freight train because it is shorter, lighter, and travels at a higher speed. The capacity consumption can be more than that of a freight train because of the need to overtake slower trains. When capacity limitation for freight trains causes them to queue on main tracks, the movement of passenger trains may cause additional delay to other traffic because of the priority movement needed on the remaining capacity in order to maintain schedule or at least minimize the delay that is caused by the queuing.

For the same reason, a passenger train (or time-sensitive freight train) may cause the capacity of the line to be reduced if operation at capacity is associated with a minimum delay because of the configuration of the line.

The major passenger-only capacity restraints in each of the identified segments are summarized below. Refer to Appendix A: Summary of Identified Capacity Constraints, for more detailed descriptions.

Portland

Portland Union Station is generally adequate for current and planned service; however, there are several limitations. (See Figure 3.2, Location 1.)

Speed – The speed limit on the Steel Bridge, immediately south of the station, is 6 mph. The six mph speed limit continues through the station to the north end. The 6 mph speed limit has a direct effect on capacity. There are two elements to the effect. First, there is a very large speed differential between freight trains and passenger trains, significantly increasing the minimum headway between a freight train and a following passenger train. Second, when all traffic is moving at the same speed, the capacity limitation of low speed can be mitigated by block length. This is only effective if the speed is great enough to allow a consistent minimum headway. At 6 mph, signals must be very closely spaced to allow a minimum headway that is consistent with the minimum headway possible between Portland and Vancouver.

There are two tracks that pass through the station and are operated as main tracks at either end, but they are operated as yard tracks through the station. Trains operate at restricted speed, which is a speed not exceeding 20 mph but prepared to stop within half the range of vision. Depending upon the weight of the train and the visibility conditions (e.g., weather, obstructions), restricted speed can be a speed much less then 20 mph. This condition does not directly affect capacity for passenger operations; however, it has an effect on capacity when a freight train passes through the station, aggravating the effect of the 6 mph speed limit on the Steel Bridge.

Track Configuration – The track configuration is generally adequate for the current and planned traffic; however, it must be utilized carefully to ensure consistency with the requirements of current and future passenger operations. Only two of the tracks (numbers 4 and 5) can be approached and entered at normal speed. Tracks 2 and 3 connect to track 4 through a turnout with a 10 mph speed limit. Also, simultaneous arrival and departure can only occur on one pair of tracks, which must always include track five. Tracks 4 and 5 also are the tracks that pass through the station and would be main tracks if signaled. Thus, there is potential conflict between passenger and freight trains, depending upon the traffic situation. This effect is aggravated by the low speed limit for freight trains.

Signal System – There is no signal system on the tracks through Portland Union Station. The Union Pacific CTC traffic control system extends south from (and including) the south end of the station. The BNSF traffic control system extends north from a point north of the north end of the station.

Vancouver, Kelso, Centralia, and Centennial Station Platform Configuration

The Vancouver station has only east side and center platforms requiring traffic to be arranged so that passenger trains use the east track to board passengers whenever possible (See Figure 3.2, Location 1). When the center platform is used trains are held out to allow passengers to cross the east track at-grade to get to the station. Depending upon the traffic situation, passenger operations at the station can result in periods of single track operations, which reduces capacity. A similar situation exists at Kelso (See Figure 3.2, Location 4), Centralia (See Figure 3.2, Location 7), and Centennial Stations (See Figure 3.2, Location 8).

Tacoma

Amtrak Station – The Tacoma Amtrak station is located on 1.2 miles of single track east of the main tracks between D Street and River Street. The time required to clear the station is further aggravated by low-speed operations (10 to 20 mph) on the station track restricting number of meet locations on the entire corridor, thereby limiting passenger scheduling options. (See Figure 3.2, Location 10.)

Tacoma Rail/Tacoma Dome Station – The Tacoma Rail line between TR Junction (the connection with BNSF) and the Tacoma Dome Station is single track except for a section of double track approximately 1,700 feet long between Portland Avenue and L Street. The speed limit is 30 mph for passenger trains (except 10 mph over switches at Portland Avenue, L Street, and G Street) and 10 mph for freight trains. (See Figure 3.2, Location 10.)

Seattle

Capacity at King Street Station (See Figure 3.2, Location 14) is limited by the following:

- Number of through tracks. Currently, two of the three through tracks are configured and dedicated for Sound Transit commuter service. Amtrak trains going through Seattle must share the remaining through track in the station.
- Limited number of simultaneous moves from the station northward to the main tracks. Northbound Amtrak trains must operate on the normally southward main track through the King Street tunnel.
- Simultaneous movements between the main tracks and the station are not possible at the south end of the station because of a short segment of single track.
- Hand throw switches on the south end of the station extend the time needed for movement on the single track segment.
- Access to the Amtrak maintenance facility is restricted by single track operations.

Everett

Passengers walking between the station and the platform used by Amtrak trains must cross the track used by Sound Transit commuter trains. Effectively, each Sound Transit train arriving and leaving uses the Sound Transit track and the main track when considering passenger train capacity. (See Figure 3.2, Location 21.)

Vancouver, British Columbia

Only one track in Pacific Central Station can accommodate an Amtrak *Cascades* trains due to the length of the enclosed customs and immigration processing area. (See Figure 3.2, Location 26.)

■ Existing and Projected Rail Demand

What Are the Current Demands on the Rail System?

Average train volumes for Washington State's major rail lines are listed in Table 3.3 and are based on representative sampling daily volumes from March and April 2006. Train volumes can vary significantly from day to day as well as seasonally.

Significant segments of the State's rail system currently are operating at or approaching their practical capacities (50 percent of theoretical) where reliable and predictable train operations can be sustained. The BNSF transcontinental main line from Seattle to Everett, then east over Stevens Pass to Spokane, routinely operates at 50 to 60 percent of theoretical capacity and regularly hits levels approaching 80 percent of theoretical capacity. As a result BNSF has been routing more intermodal trains south to Vancouver, Washington, then east along the Columbia River to Pasco, then north to Spokane.

The U.S.-Canadian border crossing currently is the most congested rail segment in the State because of customs delays and inadequate siding spacing. Trains along this line experience long delays on a regular basis. The on-time performance percentage of Amtrak's daily *Cascade* trains has decreased from 88 percent in January 2001 (80 percent for FFY 2001) to 46 percent in May 2006.

Table 3.3 Average Daily Train Volumes

Line Segment (Owner)	Split Volume (Freight/ Passenger)	Total Volume	Practical Capacity	Volume as Percent of Practical Capacity
Portland, Oregon-Vancouver, Washington (BNSF)	TBD		84	TBD
Vancouver-Seattle, Washington (BNSF)				
Vancouver-Tacoma	45/8	53	72	73.6%
Tacoma-Seattle	45/14	59	137	43.0%
Tacoma-Tukwila, Washington (UPRR)	14	14	35	40.0%
Seattle-Everett, Washington (BNSF)	40/10	50	45	111.20%
Everett, Washington-New Westminster BC (BNSF)				
Everett-Burlington	14/4	18	24	75.0%
Burlington-Ferndale	10/4	14	14.4	97.0%
Ferndale-New Westminster	10/2	12	7	171.40%
Everett-Spokane, Washington (BNSF)	25/2	27	22	122.80%
Vancouver-Pasco, Washington (BNSF)	31/2	33	36	90.6%
Auburn-Pasco, Washington (BNSF)	6/0	6	10	60.0%
Pasco-Spokane, Washington (BNSF)	33/2	35	40	87.6%
Pasco (Wallula)-Spokane, Washington (UP)	7/0	7	5/7[a]	100.0%
Spokane, Washington-Sandpoint, Idaho (BNSF)	46/2	48	102	46.6%
Spokane, Washington-Sandpoint, Idaho (UP)	8/0	8	6/8[b]	100.0%

[a] Seven for trains up to 6,700 feet in length, five for longer trains.

[b] Eight for trains up to 6,400 feet in length, six for longer trains; includes the capacity limitation between the Washington/Idaho border and the east end of the line at Eastport, Idaho.

What Are the Projected Demands on the Rail System?

The 2015 and 2025 forecast peak day average train volumes for Washington State's major rail lines are listed in Table 3.4 and are based on the forecast provided by Global Insight and increased utilization and standardization of equipment projections provided by BNSF.

Table 3.4 2015 and 2025 Forecasted Train Volumes

Line Segment (Owner)	2015 Freight[a b c]/ Passenger	2015 Total	2025 Freight[a b c]/ Passenger	2025 Total
Vancouver-Seattle, Washington (BNSF)				
Vancouver-Kalama	35/16	51	42/26	68
Kalama-Centralia	24/16	40	31/26	57
Centralia-Tacoma	21/16	37	26/26	52
Tacoma-Auburn	22/16	38	29/26	55
Auburn-Seattle	21/34	55	27/44	71
Tacoma-Tukwila, Washington (UPRR)	16	16	20	20
Seattle-Everett, Washington (BNSF)	25/10	35	31/12	43
Everett, Washington-New Westminster BC (BNSF)				
Everett-Burlington	19/6	25	21/8	29
Burlington-Ferndale	15/6	21	17/8	25
Ferndale-New Westminster	10/6	16	12/8	20
Everett-Spokane, Washington (BNSF)	20/2	22	25/2	27
Vancouver-Pasco, Washington (BNSF)				
Vancouver-Wishram	33/2	35	44/2	46
Wishram-Roosevelt	38/2	40	50/2	52
Roosevelt-Pasco	29/2	31	36/2	38
Auburn-Pasco, Washington (BNSF)				
Auburn-Yakima	13/0	13	18/0	18
Yakima-Pasco	18/0	18	24/0	24
Pasco-Spokane, Washington (BNSF)	36/2	38	48/2	50
Pasco (Wallula)-Spokane, Washington (UP)	10/0	10	11/0	11
Spokane, Washington-Sandpoint, Idaho (BNSF)	58/2	60	75/2	77
Spokane, Washington-Sandpoint, Idaho (UP)	10/0	10	11/0	11

[a] Intermodal trains – 28 cars – 270-foot per 5-well double-stack cars 100 percent utilized.

[b] Solid Waste trains – 80 cars per train at 72-foot per Singe well double-stack cars.

[c] General Merchandise trains – 108 cars per train at 60-foot per car.

The number of peak-day intermodal trains running east-west between Spokane and the ports of Seattle and Tacoma is 19 in 2015 and will be 28 in 2025. Based on input from BNSF, 70 percent of all Port of Tacoma trains will travel over Stampede Pass and the balance down I-5 and along the Gorge. All of the Port of Seattle and domestic intermodal trains will travel over Stevens Pass.

Based on these volumes and the calculated mainline capacities for 8,000-foot trains, peak day trains will exceed practical capacity on the following segments within Washington in 2015 and 2025 (Table 3.5).

Table 3.5 Locations Where Main Line Capacity Is Exceeded for 8,000-Foot Trains

2015	2025
Everett-Burlington	Everett-Burlington
Burlington-Ferndale	Burlington-Ferndale
Ferndale-New Westminster	Ferndale-New Westminster
Everett-Spokane, Washington (BNSF)	Everett-Spokane, Washington (BNSF)
Vancouver-Wishram	Vancouver-Wishram
Wishram-Roosevelt	Wishram-Roosevelt
Roosevelt-Pasco	Roosevelt-Pasco
	Pasco-Spokane, Washington (BNSF)
Pasco (Wallula)-Spokane, Washington (UP)	Pasco (Wallula)-Spokane, Washington (UP)
Spokane, Washington-Sandpoint, Idaho (UP)	Spokane, Washington-Sandpoint, Idaho (UP)
Auburn-Yakima	Auburn-Yakima
Yakima-Pasco	Yakima-Pasco

The BNSF will have to invest significant capital within Washington in order to expand sidings and yards to accommodate 8,000-foot trains based on the forecasted growth.

How Are Railroads Addressing These Capacity Constraints?

The railroads are promoting several strategies described below to add capacity without making significant infrastructure investment. These strategies have been incorporated in the forecast train volumes shown is in Table 3.4.

Improved Slot Utilization

Improving locomotive and car velocity are the keys to achieving the service and capacity needed to handle the forecasted growth in rail traffic. These capacity improvements will be made in several different ways:

- **Line Throughput –** Move more traffic over each route. This includes increasing the number of trains that can move over a line and the average speed at which they move across the route.

- **Terminal Throughput –** Standardize terminal processes and optimize terminal resources.

- **Locomotive Distribution –** Position locomotives in the right place at the right time and turn them faster.

- **Maintenance Reliability –** Use maintenance activities everywhere to make the assets more available to improve velocity.

- **Capital Improvements –** Make the capital investments in expansion of the physical plant (additional track, facilities, and equipment, without which future velocity improvements would not be possible).

- **Train Size/Capacity –** Increase train size and number of units per train.

- **Train Design –** Design and build trains at origin to reduce terminal handling down the line.

For intermodal trains, capacity is improved by increasing the number of cars per train and units per car. This is accomplished by running longer trains, maximizing slot utilization, and optimizing the five-well double-stack railcar length.

Running longer trains, up to 8,000 feet, allows railroads to run about the same number of trains while handling 20 percent more volume. The operation of 8,000-foot trains is an operating practice, which will be discussed in the Task 4 Technical Memorandum. The practice of running 8,000-foot trains will result in some additional infrastructure requirements.

Maximum slot utilization is accomplished when every space available is used on a double-stack car. A five-platform double-stack car has 10 slots available for loading. If all 10 slots are loaded, you have 100 percent slot utilization. The Northwest ports are realizing less than optimal slot utilization today at 70 percent for westbound trains.

For BNSF, intermodal slot utilization was up 1 percent to 93 percent in 2004; each percentage point of increase equals about 800 intermodal platforms per day of additional capacity (Table 3.6).

Table 3.6 BNSF Stack Trains Statistical Trends

Year	Number of Units	Percent Utilization
2001	N/A	90.1%
2002	N/A	91.8%
2003	196	92.0%
2004	207	93.0%
2005	214	93.3%

Optimizing the Railcar Length for double-stack railcars is an initiative that BNSF is undertaking to minimize the rail car length per container ratio. Today, double-stack railcars vary in length from 70 feet for a single-well double-stack railcar to 325 feet for a five-well double-stack railcar. The industry average used for purposes of estimating capacity is 305 feet.

In order to maximize the mainline capacity the BNSF is developing dedicated, 40-foot container-only, five-well double-stack cars that are 270 feet long.

Railcar Length per Container

The standard five-well (270 feet) railcar combined with the improved intermodal slot utilization results in 27 feet of railcar utilized per 40-foot container. This compares quite favorably with 43.57 railcar feet/container of today's five-well (305 feet) double-stack cars with 70 percent slot utilization. The combined slot utilization increase with use of dedicated 270-foot railcars results in a 56 percent capacity improvement for international intermodal.

■ Planned Capacity Improvements

What Are the Currently Funded Capacity Improvement Projects in Washington?

The projects in Table 3.7 are either fully or partially funded relating to main line, terminal access, or secondary line capacity projects. The majority of the funded north-south projects between Vancouver, WA and Blaine, WA are related to the State's passenger rail program. Many of the projects appearing in Table 3.7 are also shown in Figure 3.3, Washington State Identified Funded Projects.

Table 3.7 Funded Rail Projects

Location	Project Name	Funding ($1,000s)	Funding Biennium	Source
Vancouver, WA	Vancouver Rail Line Project (incl. 39th St.)	$109,950	2005-2011	WSDOT
Lewis Co.	Chehalis Jct. Crossovers	$3,900	2013-2015	WSDOT
Bellingham, WA	Bellingham Georgia Pacific Curve	$180	2007-2009	WSDOT
Kalama-Longview, WA	Kelso-Martin's Bluff 3rd Mainline	$53,068	2011-2015	WSDOT
BNSF Seattle Sub	Centennial High-Speed Crossovers	$3,875	2006	WSDOT
BNSF Seattle Sub	Tenino High-Speed Crossovers	$3,875	2007-2009	WSDOT
Lewis Co.	Newaukum High-Speed Crossovers	$3,490	2013-2015	WSDOT
Winlock, WA.	Winlock High-Speed Crossovers	$3,925	2006	WSDOT
Mount Vernon, WA	Mount Vernon Siding Upgrade	$3,800	2006	WSDOT
Everett, WA	PA Jct. Curve Realignments and Delta Yard Storage Tracks	$14,000	2005-2007	WSDOT
Stanwood, WA	Stanwood Siding Upgrades	$3,000	2007-2009	WSDOT
Blaine, WA	Swift Customs Facility/Blaine & White Rock	$9,000	2006-2009	WSDOT
Seattle, WA	King Street Station Track Impr.	$15,000	2006-2011	WSDOT
Pierce Co.	Pt. Defiance Bypass Phase 1	$59.6	2007-2009	WSDOT
Everett, WA	Snohomish Riverfront Redevelopment	$1,800	2006	WSDOT
Bellingham, WA	Bellingham Waterfront Restoration Project	$5,000	2009	WSDOT
Cosmopolis, WA	Cosmopolis Bypass Port of Grays Harbor	$765	2007	WSDOT
Pasco, WA	Port of Pasco Intermodal Facility Improvements	$5,400	2006	WSDOT
Chehalis & Centralia, WA	Chehalis Jct. to Blakeslee Jct.; via Centralia	$7,400	2006	WSDOT
Seattle – Tacoma, WA	Sound Transit Phase 1 and 2	$304,000	Under construction	Sound Transit
Seattle – Everett, WA	Sound Transit (Seattle – Everett)	$207,000	Under construction	Sound Transit
Auburn – Seattle, WA	Phase 3 Improvements, Argo-Black River, Sound Transit	N/A	Not yet determined	Sound Transit
Tacoma, WA	Port of Tacoma Bullfrog/Chilcote Jct. Improvements	N/A	Under construction	Port of Tacoma
BNSF Fallbridge Sub	Lyle siding extension	N/A	Under construction	BNSF
BNSF Stampede Sub	BNSF Stampede Pass Tunnel Clearance	N/A	Not yet determined	BNSF

Key main line capacity projects include:

- Vancouver Rail Line Project, provides add capacity to meet freight trains off the main line;
- Point Defiance Bypass Project, reduces Cascades trains running times and bypasses congested Nelson Bennett Tunnel; and
- Kelso-Martin Bluff 3rd Main Line, routes Cascades trains around congested terminal access points to the Ports of Kalama and Longview.

Funding sources include the Washington's LEAP Transportation Document 2006-C, Rail Capital Program dated March 6, 2006; Sound Transit; Port of Tacoma; and the BNSF capital projects plan. A complete listing of state-funded rail projects is available in LEAP Transportation Document 2006-C, Rail Capital Program.

What Are the Currently Identified Capacity Improvement Projects in Washington?

A list of State rail projects has been compiled from previous studies and proposals. The preponderance of the north-south projects between Vancouver, WA and Blaine, WA are part of the WSDOT passenger program plan. The early WSDOT rail projects generally address recovery of main line capacity for through-train movements. The later projects generally address the infrastructure required for higher speeds and an increase in the number of passenger trains. A complete implementation program for these projects is found in *Draft Long-Range Plan for Amtrak Cascades*, WSDOT, February 2006.

Table 3.8 lists the currently identified rail projects, the capacity limitations they are intended to address, and what benefits/mitigation they are intended to provide. Figures 3.3 and 3.4 show the location of the 98 identified rail projects, with the funded projects (40 total) shown on Figure 3.3, and unfunded projects (58 total) shown in Figure 3.4. No operational analysis was performed on the listed projects as part of this Study. This list will serve as a basis for identifying various corridor/sector improvements that may be considered to add capacity to the State's main lines, secondary lines, and rail terminals. Additional projects may be identified during the course of the project as the industry reviews this report and other WTC study documents.

Figure 3.3 Washington State Identified Funded Rail Projects

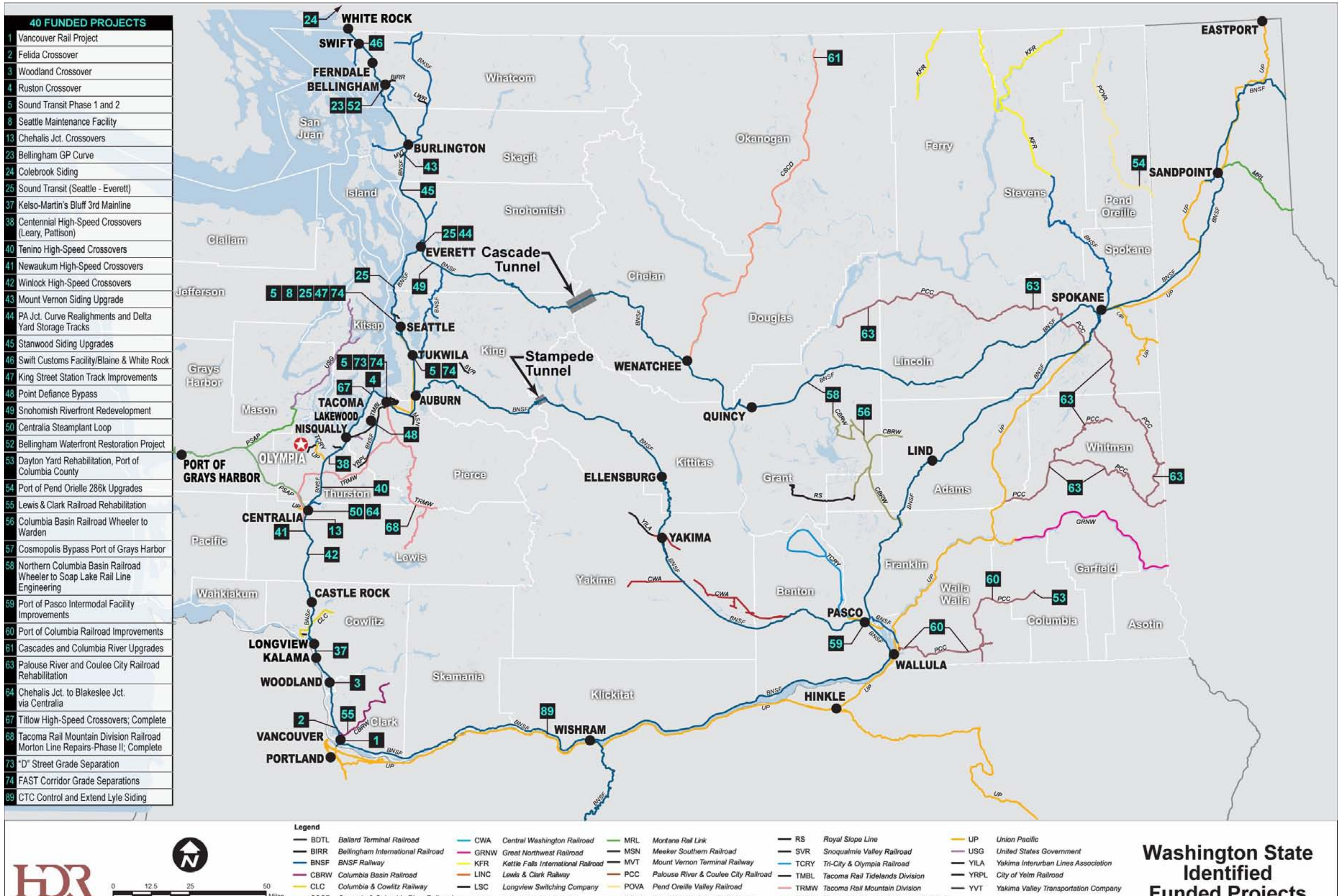


Figure 3.4 Washington State Identified Unfunded Rail Projects

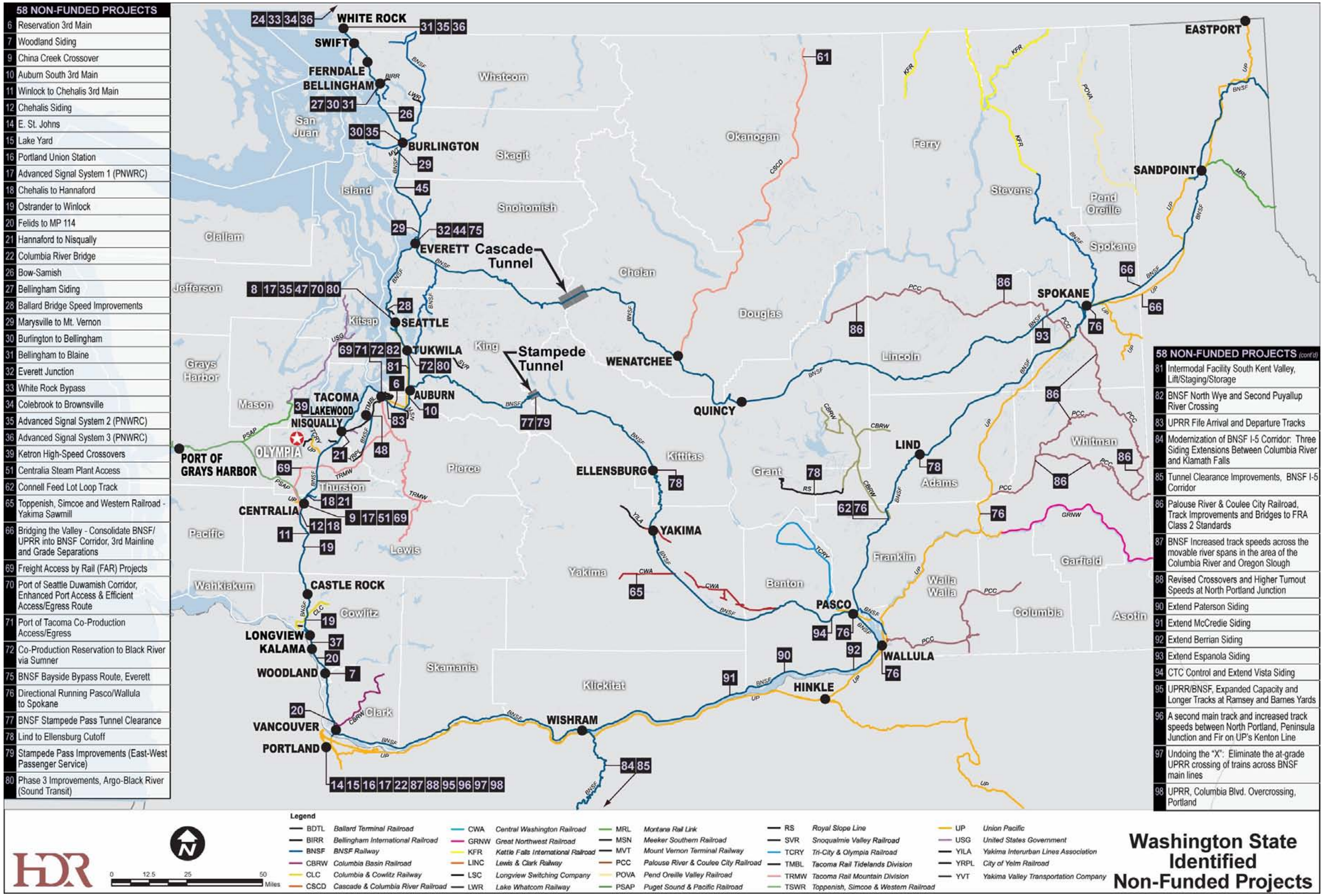


Table 3.8 Identified State Rail Projects

ID No.	State(s) Benefited	Problem Type	Project Name / Solution Type	Funding	Proposer	Beneficiary	Sectors Benefitted	
							Primary	Secondary
98 Projects								
1	WA	1, 2, 3, 4, 5, 6, 13, 17	**Vancouver Rail Project** A, B, C, D, F, I, K, M, P	Cunded	A	C, D, E	A, I, M, P, X	
2	WA	4, 14	**Felida Crossover** I	Complete	A	C, D, E	A, I, M, P	
3	WA	3, 10, 11, 14	**Woodland Crossover** I	Complete	A	C, D, E	A, I, M, P	
4	WA	2, 3, 4, 14	**Ruston Crossover** I	Complete	A	C, D, E	A, I, M, P	
5	WA	1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 17, 18, 23	**Sound Transit Phase 1 and 2** A, B, C, D, E, F, G, I, K, M, N, P	Funded	F	C, D, E, F	A, I, M, P	
6	WA	2, 3, 4, 6	**Reservation 3rd Main** A, B		A	C, D, E, F	A, I, M, P	
7	WA	3	**Woodland Siding** A		A	C, D, E	A, I, M, P	
8	WA	2, 3, 5, 6, 23	**Seattle Maintenance Facility** A, B	Partial	A, E	C, E, F	P	A, I, M
9	WA	13	**China Creek X-Over** I		A	C, D	A, I, M	
10	WA	4, 10, 12	**Auburn South 3rd Main** A, C		A	C, D, E, F	A, I, M, P	
11	WA	10, 15	**Winlock to Chehalis 3rd Main** C		A	C, D, E	A, I, M, P	
12	WA	3	**Chehalis Siding** A		A	C, D, E	A, I, M, P	
13	WA	15, 17	**Chehalis Jct. X-Overs** M	2013-2015	A	C, D, E	A, I, M, P	
14	OR	2, 3, 4, 6, 23	**E. St. Johns** A, B, F		A	C, E	I, M, P	
15	OR	2, 3, 6, 23	**Lake Yard** B, F, M, P		A	C, E	I, M, P	
16	OR	21	**Portland Union Station** A		A	A, E	M, P	
17	WA	19, 22	**Advanced Signal System 1 (PNWRC)** J		A	A, E	P	
18	WA	10	**Chehalis to Hannaford** C		A	C, D, E	A, I, M, P	
19	WA	10	**Ostrander to Winlock** C		A	C, D, E	A, I, M, P	
20	WA	10	**Felida to MP 114** C		A	C, D, E	A, I, M, P	
21	WA	10, 13	**Hannaford to Nisqually** A, C, O		A	C, D, E	A, I, M, P	
22	WA/OR	17, 20	**Columbia River Bridge** B, L		A	C, D, E	A, I, M, P	
23	WA	7, 9, 15, 17	**Bellingham GP Curve** M	2007-2009	A	C, E	M, P	
24	WA	9	**Colebrook Siding** H	Partial	A	C, E	M, P	
25	WA	1, 2, 3, 4, 6, 7, 8, 9, 10, 14, 16, 17, 23	**Sound Transit (Sea - Everett)** A, B, F, H, I, K, M, N	Funded	F	C, D, E, F	I, M, P	
26	WA	9, 10	**Bow - Samish** C, H		A	C, E	M, P	
27	WA	9	**Bellingham Siding** H, U		A	C, E	M, P	
28	WA	17	**Ballard Bridge Speed** M		A	C, E, F	I, M, P	
29	WA	9, 10	**Marysville to Mt. Vernon** C, H		A	C, E	M, P	
30	WA	9, 10	**Burlington to Bellingham** C, H		A	C, E	M, P	
31	WA	9, 10	**Bellingham to Blaine** C, H		A	C, E	M, P	
32	WA	9	**Everett Junction** H		A	C, E, F	I, M, P	

Legend

Category		Problem Types
A	1	Trains stopped on main tracks during crew change.
A	2	Trains occupying main tracks for an extended time while doubling into and out of yards.
A	3	Trains occupying main tracks for an extended time while setting out, picking up, or switching.
A	4	Trains stopped on main tracks awaiting accommodation in yards or on connecting routes.
C	5	Route conflict among commonly used routes.
A	6	Low speed entering and leaving main tracks.
F	7	Low speed operation on main tracks (regulatory).
B	8	Signal spacing / speed combination (multiple track excess headway).
C	9	Siding spacing / speed combination (single track).
D	10	Speed differential (Passenger / Freight)
C	11	Speed Differential (Freight / Freight)
D	12	Speed Differential (Passenger / Passenger)
D	13	Single side station (passenger access across main tracks)
C	14	Maintenance of Way access to tracks (track out of service for maintenance of way causes extensive capacity limitation)
F	15	Speed on grades.
B	16	Low speed operation on main tracks (yard limits).
E	17	Low speed operation on main tracks (track geometry, track condition, structure condition).
B	18	Written movement authority procedures.
B	19	Weather related speed reduction for reduced signal visibility.
F	20	Marine Navigation
D	21	Passenger train use of main tracks at stations.
B	22	Signal system for high speed operation.
B	23	Trains stopped for hand throw switches
F	24	Highway crossings limit railroad operations
F	25	Line capacity required beyond improvement of existing facility
E	26	Condition limits traffic type
A	27	Inadequate yard track length, quantity, configuration
C	28	Inadequate Siding Length
A	29	Trains block yard operation for an extended time while setting out, picking up, or switching.
A	30	Trains block yard operation for an extended time while doubling into and out of yards.

Table 3.8 Identified State Rail Projects

ID No.	State(s) Benefited	Problem Type	Project Name / Solution Type	Funding	Proposer	Beneficiary	Sectors Benefitted: Primary	Sectors Benefitted: Secondary
98 Projects								
33	WA/BC	9, 10	**White Rock Bypass** C, H		A	C, E	P	M
34	BC	9, 10	**Colebrook to Brownsville** C, H		A	C, E	P	M
35	WA	19, 22	**Advanced Signal System 2** J		A	A, E	P	
36	BC	19, 22	**Advanced Signal System 3** J		A	A, E	P	
37	WA	2, 3, 4, 5, 6, 10, 11, 13, 14, 23, 27	**Kelso-Martin's Bluff 3rd Mainline** A, B, C, D, F, I, K, M, P, T	Phase 1 2011-2015	A	C, D, E	A, I, M, P, X	
38	WA	13	**Centennial High-Speed Crossovers (Leary, Pattison)** I	Funded	A	C, D, E	A, I, M, P	
39	WA	10, 14	**Ketron High-Speed Crossovers** I		A	C, D, E	A, I, M, P	
40	WA	10, 11, 14	**Tenino High-Speed Crossovers** I	2007-2009	A	C, D, E	A, I, M, P	
41	WA	10, 14, 15	**Newaukum High-Speed Crossovers** I	2013-2015	A	C, D, E	A, I, M, P	
42	WA	10, 14, 15	**Winlock High-Speed Crossovers** I	Funded	A	C, D, E	A, I, M, P	
43	WA	9, 10	**Mount Vernon Siding Upgrade** H, U	Funded	A	C, E	M, P	
44	WA	2, 4, 5, 9, 16, 17, 23	**PA Jct. Curve Realignments and Delta Yard Storage Tracks** A, E, H, K, M, P	Phase 1 funded	A	C, E	M, P	
45	WA	9, 10	**Stanwood Siding Upgrades** H	Phase 1 2007-2009	A	C, E	M, P	
46	WA	3, 4	**Swift Customs Facility/Blaine & White Rock** A, D	2005-2010	A, C, E, M	C, E	M, P, Y	
47	WA	2, 3, 5, 6, 17, 23	**King Street Station Track Improvements** A, B, D, F, K, M, O	Phase 1 2005-2011	A, E, F	C, D, E, F	P	A, I, M
48	WA	9, 10	**Pt. Defiance Bypass** Phase-1 C, H	Phase 1 2005-2009	A	C, D, E, F	A, I, M, P	
49	WA	3, 6, 16, 17, 23	**Snohomish Riverfront Redevelopment** A, E, M	Funded	N	C	Y	M
50	WA	1, 2, 3	**Centralia Steamplant Loop** A	Complete	O	C, D, E	Coal, A, I, M, P	
51	WA	6, 23	**Centralia Steam Plant access** E, M		A	C, D, E	Coal, A, I, M, P	
52	WA	7, 9, 15, 16, 17, 18	**Bellingham Waterfront Restoration Project** E, H, M	2007-2009	P	C, E	Y	M
53	WA	26	**Dayton Yard Rehabilitation, Port of Columbia County** S	Funded	B	BLMR	A, M	
54	WA	26	**Port of Pend Oreille 286k Upgrades** S	Funded	B	POVA	M	
55	WA	17, 26	**Lewis and Clark Railroad Rehabilitation** M, S	Funded	Q	CBRW	M	
56	WA	17, 26	**Columbia Basin Railroad Wheeler to Warden** M, S	Funded	B	Y	A, M	
57	WA	27	Cosmopolis Bypass Port of Grays Harbor T	2007-2009	B	Z	A, M	
58	WA	17	**Northern Columbia Basin Railroad Wheeler to Soap Lake Rail Line Engineering** M	Funded	B	Y	A, M	
59	WA		Port of Pasco Intermodal Facility Improvements	Funded			I	
60	WA		Port of Columbia Railroad Improvements	2007-2013		Port of Columbia (BLMR)	A, M	
61	WA		Cascades and Columbia River Upgrades	Funded		CSCD	A, M	
62	WA		Connell Feedlot Loop Track			C or Y	A	
63	WA	17, 26	**Palouse River and Coulee City Railroad Rehabilitation** M, S	2005-2013		B, W	A, M	
64	WA	1, 6, 8	**Chehalis Jct. to Blakeslee Jct.; via Centralia** D, G, P	Funded	B	C, D, E	A, M	

Legend

A	31	Yard operation must use main tracks

Category	Description
A	Yard infrastructure
B	Signal and traffic control systems
C	Main line infrastructure (except signal and traffic control)
D	Passenger operation
E	Infrastructure condition
F	Geography, geology, topography, regulation

	Solution Types
A	Additional track to accommodate stopped trains
B	Additional track for low speed operation.
C	Additional track to accommodate overtaking.
D	Additional track to reduce route conflict duration / eliminate route conflict.
E	Traffic Control Systems (CTC).
F	Additional crossovers / turnouts to increase flexibility.
G	Reduce duration of block occupancy (change signal spacing and / speed).
H	Reduce time between sidings (change spacing and / or speed).
I	Additional crossovers to reduce length / duration of single track operation.
J	Advanced signal system.
K	Change normal use of existing tracks.
L	Change drawbridge type
M	Improve track geometry, track condition, structure condition for higher speed
N	Eliminate regulatory speed limits
O	Change station design
P	Power existing hand throw switches
Q	Grade separation
R	Additional track to increase capacity
S	Modify existing route to accommodate additional traffic types
T	Modify yard track length, quantity, configuration
U	Increase length of sidings

Table 3.8 Identified State Rail Projects

ID No.	State(s) Benefited	Problem Type	Project Name / Solution Type	Funding	Proposer	Beneficiary	Sectors Benefitted Primary	Sectors Benefitted Secondary
98 Projects								
65	WA	17, 26	Toppenish Simcoe and Western Railroad - Yakima Sawmill M, S		B	X	M	
66	WA/ID	9, 24	Bridging the Valley, Consolidate BNSF/UPRR into BNSF Corridor, 3rd Mainline and Grade Separations H, Q		R	C, D	A, I, M, X	P
67	WA	4, 14	Titlow High-Speed Crossovers; Complete I	Complete	A	C, D, E	A, I, M, P	
68	WA	17	Tacoma Rail Mountain Division Railroad Morton Line Repairs-Phase II; Complete M	Funded	V	V	M	
69	WA	4, 17	Freight Access By Rail (FAR) projects M		B, U	C, D, V	A, I, M	
70	WA	2, 5, 17, 23	Port of Seattle Duwamish Corridor, Enhanced port access and efficient access/egress route. B, D, E, F		G	C, D, G	I	
71	WA	1, 2, 5, 17, 23	Port of Tacoma Co-Production Access/Egress A, B, D		H	C, D, H	I, M	A, P
72	WA	8, 9, 10	Co-Production Reservation to Black River via Sumner K		T	C, D, T	A, I, M	P
73	WA	24	"D" Street Grade Separation Q	Funded	S, T	C, D	A, I, M, P, X	
74	WA	24	FAST Corridor grade separations Q	Continuing	S, T	C, D	A, I, M, P, X	
75	WA	5, 6, 8, 16, 17, 23	BNSF Bayside bypass Route, Everett E, K, M		C	C, E, F	M	
76	WA	9, 10, 11	Directional running Pasco/Wallula-Spokane K		C	C, D	A, I, M	
77	WA	25	BNSF Stampede Pass Tunnel Clearance S		C, T	C	I	
78	WA	8, 9, 10, 11, 25	Lind to Ellensburg Cutoff R		A/B	C, E	I	M, P
79	WA	9, 18	Stampede Pass Improvements (East-West passenger service) E, H		A	C, E	P	I, M
80	WA	2, 3, 5, 6, 17, 23	Phase 3 Improvements, Argo-Black River, Sound Transit B, F, K		F	C, D, E, F	A, I, M, P	
81	WA		Intermodal Facility South Kent Valley, Lift/Staging/Storage				I	
82	WA	9, 17	BNSF North Wye and Second Puyallup River Crossing B, D		H	C, D, H	I, M	
83	WA	2, 4	UPRR Fife Arrival and Departure Tracks A		D	D, H	I, M	
84	OR	9	Modernization of BNSF I-5 Corridor, 3 Siding Extensions Between Columbia River and Klamath Falls H			C	I, M	
85	OR	26	Tunnel Clearance Improvements. BNSF I-5 Corridor S			C	I	
86	OR	26	Palouse River & Coulee City Railroad, Track Improvements and Bridges to FRA Class 2 Stds. M, S		B	W	A, M	
87	OR	17	BNSF, Increased track speeds across the movable river spans in the area of the Columbia River and Oregon Slough M		A, L	C, D, E	A, I, M, P	
88	OR	5, 6	Revised crossovers and higher turnout speeds at North Portland F, M		A, L	C, D, E	A, I, M, P	
89	WA	9, 28	CTC control and Extend Lyle siding E, U	Funded	C	C	A, M	I, P
90	WA	9, 28	Extend Paterson Siding U	BNSF Capital program 2010	C	C	A, M	I, P
91	WA	9, 28	Extend McCredie Siding U	BNSF Capital program 2010	C	C	A, M	I, P

Legend	
	Proposers / Beneficiaries
A	Washington State Department of Transportation Passenger Rail Program
B	Washington State Department of Transportation Freight Rail Program
C	BNSF Railway
D	Union Pacific Railroad
E	Amtrak
F	Sound Transit
G	Port of Seattle
H	Port of Tacoma
I	Port of Vancouver
J	Port of Portland
K	Oregon Department of Transportation
L	Portland - Vancouver I-5 Corridor Transportation and Trade Partnership
M	USDOT
N	City of Everett
O	TransAlta
P	Port of Bellingham
Q	Clark County
R	Spokane Regional Transportation Council
S	Puget Sound Regional Council
T	WSDOT
U	Thurston County
V	Tacoma Rail
W	Palouse River & Coulee City Railroad
X	Toppenish Simcoe & Western Railroad
Y	Columbia Basin Railroad
Z	Port of Grays Harbor

Table 3.8 Identified State Rail Projects

ID No.	State(s) Benefited	Problem Type	Project Name / Solution Type	Funding	Proposer	Beneficiary	Sectors Benefitted Primary	Sectors Benefitted Secondary
98 Projects								
92	WA	9, 28	Extend Berrian Siding U	BNSF Capital program 2010	C	C	A, M	I, P
93	WA	9, 28	Extend Espanola Siding U	BNSF Capital program 2010	C	C	I	M, P
94	WA	4	CTC control and Extend Vista siding E, U		C	C	A, M	
95	OR	4	UPRR / BNSF, Expanded capacity and longer tracks at Ramsey and Barnes yards A, T		L	C, D, E	I, M	
96	OR	5, 6, 9, 17	A second main track and increased track speeds between North Portland, Peninsula Junction, and Fir, on UP's Kenton Line H, M		A, L	C, D, E	A, I, M, P	
97	OR	5, 6, 17	Undoing the "X". Eliminate the at-grade UPRR crossing of trains across BNSF main lines B, D		L	C, D, E	A, I, M, P	
98	OR	23	UPRR, Columbia Blvd Overcrossing, Portland Q		L	C, D, E	A, I, M	P

Legend

Sectors Benefitted	
A	Agriculture & Food
I	Intermodal
M	Manufactured Goods
P	Passenger
X	Public Non-Rail Transportation
Y	Public Non-Transportation

Appendix A

Descriptions of Identified Rail Constraints

Where Are the Rail Network Constraints?

Capacity constraints can be related to a piping or "hose analysis." The capacity of the hose is limited to the capacity of the smallest diameter piece. If there are several pieces that have the same limiting diameter, the capacity will not increase until all of the pieces of that diameter have been replaced with segments of larger diameter. When they are replaced, the capacity of the hose is still no more than the capacity of the next smallest diameter piece. The size of the replacement of the smallest diameter hose is unimportant as long as it is at least as large in diameter as the next larger piece. However, if the capacity of the hose is being increased to a particular goal, it makes sense to replace the smaller segments with segments that have at least the goal capacity so that they do not need to be replaced again.

Known capacity constraints within each of the State's major rail corridor are briefly described in the following sections. The capacity constraints are presented in geographical order and do not represent any prioritization.

Portland, Oregon-Vancouver, Washington

The capacity limitations between Portland, Oregon and Vancouver, Washington are most readily described by type of limitation. There are three significant limitations on capacity between Portland and Vancouver. (See Figure 3.2, Location 1.)

Low-Speed Operation

The speed limit for all diverging movements at Willbridge (crossovers) and North Portland Junction (Port of Portland and UP connections and crossovers between main tracks) is 10 mph. The speed limit for trains on the Fallbridge Subdivision (Vancouver-Pasco route) at Vancouver is 10 mph. Each of these movements occupies the same capacity as approximately three through trains.

The speed limit over the Steel Bridge in Portland and for about 2,000 feet north of the Steel Bridge is 6 mph. There is little freight traffic in this area, but each train occupies a main track between Portland and Lake Yard for about 30 minutes.

Trains Stopped on Main Tracks

Several freight trains per day stop on a main track at Lake Yard, Willbridge, and North Portland Junction while setting out and picking up. Each of the stopped trains occupies the same capacity as three or more through trains.

Drawbridges

The Willamette River and Columbia River drawbridges (the Oregon Slough bridge is open for marine navigation infrequently) are open for an aggregate duration equivalent to about 24 train per day.

Vancouver (Portland-Seattle/Vancouver-Pasco)-Seattle (South Portal)

Vancouver

There is an array of significant capacity limitations at Vancouver. Capacity that appears at first glance to be at least 12 trains per hour can be half of that or less for most of a day. (See Figure 3.2, Locations 2 and 37.)

Low-Speed Operation – All trains entering or leaving Vancouver yard or moving between the Portland-Seattle route and the Vancouver-Pasco route move at 10 mph. Depending upon the specific movement, a train may occupy both of the Portland-Seattle main tracks and the Vancouver-Pasco main tracks consuming the same capacity as three to six through trains.

Trains move at 10 mph between Vancouver Yard (or Vancouver-Pasco main line) and Port of Vancouver crossing the Portland-Seattle main line at-grade. Each of these trains consumes the same capacity as six trains on the Portland-Seattle route.

Trains Stopped on Main Tracks – All trains moving between the Portland-Seattle route north of Vancouver and the Vancouver-Pasco route change crews at Vancouver. These trains occupy at least one of the Portland-Seattle and/or Vancouver-Pasco main tracks for 10 minutes or longer during the crew change. Trains moving from one route to another that cannot be accommodated immediately (e.g., traffic or crew availability), occupy one of the Portland-Seattle main tracks north of Vancouver or one of the Vancouver-Pasco main tracks east of Vancouver, causing single track operation on the remaining main track of the route and significantly reducing capacity.

Trains also stop on the main lines because the tracks in Vancouver yard do not accommodate the length of typical freight trains. Originating freight trains will often occupy one of the Portland-Seattle main tracks for an extended period while assemble a full train for departure. Also, the yard can generally not accommodate through trains that must set our or pick up cars at Vancouver. These trains also occupy one of the main tracks for extended periods switching cars consuming the capacity of six through trains.

Woodland-Castle Rock

A significant amount of the capacity between Woodland and MP 85 (near Castle Rock; see Figure 3.2, Locations 3 and 38) is consumed by standing trains. Some of the service at Kalama and most of the service at Longview Junction is provided by through trains that must stop on one of the main tracks while setting out or picking up cars. Trains servicing the two grain terminals at Kalama occupy a main track for extended periods due to 10 mph speed restriction accessing yard tracks and the time required to hand throw switches. There is an auxiliary track extending between the Cenex-United Harvest and Kalama Export Company grain terminals; however, it is often not available for train movement because of the need to store cars for the grain terminals or other local industries. When the track is available, it is not generally practical for use by a stopped train to clear the main track because of the hand throw switches that connect it to the main tracks. Until about 20 years ago, all freight trains had a caboose staffed with personnel available to restore hand throw switches to the correct position after use. Freight trains no longer have personnel station at the rear, so restoring a hand throw switch behind a train to the correct position generally involves a crew member from the front of the train waiting by the switch for the train to pass, restoring the switch to the correct position, and walking back to the front of the train.

Vader-Chehalis

The ruling grade in both directions on the Portland-Seattle route is between Vader and Chehalis (Napavine Hill; see Figure 3.2, Location 5). Freight trains generally ascend this hill at speeds well below 30 mph, often as low as 15 mph. The signal block lengths are similar to the block lengths on the higher speed tracks of the rest of the corridor. Therefore, the capacity of this part of the route is less roughly 30 percent than the level segments immediately to the north or south due to underpowered low-speed trains.

The low-speed freight operations on this segment aggravate the speed differential between freight and passenger trains increasing the capacity consumed by passenger trains overtaking freight trains.

As a freight train ascends the hill at 20 mph, following freight trains are overtaking it at 30 mph while passenger trains are overtaking it at 60 mph. The headway between similarly powered freight trains will (were it not for the effect of block lengths) return to the headway approaching the hill. As each train passes the summit, it accelerates while the train behind is losing speed ascending the hill. Freight trains with sufficient power to ascend the hill at near normal speed (generally intermodal trains) and passenger trains will not regain the headway lost while the preceding train was ascending the hill. The point at which it overtakes the train ahead is 10 to 15 minutes (as little as seven miles for a passenger train and 10 miles for a freight train) closer than it would have been given the speed differential on the Napavine Hill grade.

The speed differential and overtaking capacity also are a consideration on the rest of the route. Before Northern Pacific installed CTC between Vancouver and Wabash (near Centralia) in the early 1960s, there were sidings were spaced approximately every eight miles to allow overtaking. The installation of CTC between Vancouver and Wabash in the early 1960s eliminated the need for overtaking sidings, given the low traffic volume of the era. Today, the need to restore overtaking capacity is increasing due to heavy traffic and train speed differentials ranging from 35 to 45 mph for grain trains, 50 to 60 mph for most other freight trains, and 79 mph for the passenger trains.

Centralia

North of Centralia yard, there is a junction with a line leading east to a coal-fired power plant. Recent construction of a loop unloading track at the power plant has eliminated the need for unit coal trains to occupy the main line when serving the plant. Capacity at this location is still partially constrained by a 10 mph speed restriction through a hand thrown switch. This remaining constraint consumes the capacity of three through trains for every coal train.

The Puget Sound & Pacific line between the Port of Grays Harbor and Centralia has experienced significant growth in unit trains of bulk commodities. These trains enter and leave the main track at 10 mph at Centralia and change crews at the passenger station. Each train can consume the capacity of three to six through trains.

Several trains per day stop at Centralia, occupying a main track while setting out or picking up. Each of these trains occupies the capacity of three to six through trains. (See Figure 3.2, Locations 6 and 7.)

Ruston-Nelson Bennett

The Ruston and Nelson Bennett tunnels under Point Defiance in Tacoma were originally double track tunnels (see Figure 3.2, Location 9). By 1970, car sizes had increased to a point were many of the freight trains would not fit on the east track because of restricted overhead and side clearances. Crossovers were constructed at both ends of the tunnels and CTC was installed to allow freight trains with oversized cars to use the west track through the tunnel. Passenger trains and unrestricted freight trains could use either track, preserving double track operation. The resulting capacity limitation was not significant for the traffic of the era.

In the early 1990s, BN converted the Ruston and Nelson Bennett Tunnels to single track to accommodate double-stack intermodal trains. The soils that the tunnels are constructed in make them impractical to enlarge. A new tunnel on an offset alignment would need to be constructed to restore the original double track section.

This single track section limits capacity on the entire corridor to 72 trains per day. Freight speeds through this track section can be increased from 40 to 50 mph, increasing capacity by about four trains per day. Currently, 10 Amtrak passenger trains use the line daily. These trains could be routed onto Sound Transit's Lakeview Line. After improvements to the Sound Transit Lakeview line the combined capacity of the lines could be increased to over 135 trains per day.

Tacoma

The speed limit on the Thea Foss curve (also known as Head of Bay curve) at Tacoma currently is 10 mph. The signal spacing through Tacoma is designed for the speed restriction.

BNSF's Tacoma yard tracks are less than that of a typical freight train, so several trains per day must stop on a main track to set out or pick up. Trains that originate or terminate in Tacoma must double into the Tacoma or Log Yard tracks, occupying one or both main tracks for an extended period restricting through train operations to a single main track.

Trains accessing the yard at the south end are restricted to 10 mph. This does not result in a capacity restriction since the speed around the Thea Foss curve currently is restricted to 10 mph. Trains entering and leaving the north end of the yard also are restricted to 10 mph. Each train entering or leaving the yard consumes the capacity of at least three through trains (exclusive of time spent doubling on the main tracks). Most trains must double together before leaving, further reducing the capacity because of the extended occupancy by standing trains. (See Figure 3.2, Locations 10, 11, 39, and 40.)

Auburn

Auburn Yard and the connection to the Auburn-Pasco line are both located on the east side of the line. Trains are restricted to 10 mph when entering or leaving Auburn yard or the Auburn-Pasco route from the north (Seattle). Each of these trains consumes the capacity of three or more through trains. (See Figure 3.2, Location 12.)

Tukwila-Argo

A recent Sound Transit infrastructure project has eliminated most of the route conflicts and speed differential conflicts between Tukwila and Argo; however, some capacity limiting conflicts remain.

There are three tracks north of and south of the Tukwila and Argo control points; however, only two trains may operate simultaneously through either control point. Trains to and from South Seattle yard and UP Argo yard enter and leave the west main track at 10 mph.

Union Pacific trains must cross the BNSF main tracks when switching cars between Union Pacific's Argo and Van Asselt yards. The Van Asselt yard provides staging support for Union Pacific's Argo intermodal operations. These crossing movements are made at 10 mph. Each crossing move consumes the capacity of at least two through trains. At Rhodes or Tukwila, UP trains en route to or from Van Asselt/Manar yards must cross over the BNSF main lines to access Black River Junction consuming the capacity of at least two trains on the Portland-Seattle route. (See Figure 3.2, Location 13 and 42.)

Argo-South Portal

Trains from the SIG/Stacy yard entering the main track at 10 mph at the Coach Wye, the hand throw switches at the south end of King Street Station and the location of the passenger car maintenance yard on the opposite side of the main tracks from King Street

Station are the significant limits on the capacity of this section. Once the Sound Transit infrastructure projects currently under construction in this area are completed in 2008, there will be no significant infrastructure constrains remaining. (See Figure 3.2, Locations 14 and 44.)

Tacoma-Tukwila (Union Pacific RR)

Trains doubling in and out of the yard at Fife must occupy the main track for an extended time. Trains setting out or picking up at the auto unloading facility is south of Kent must occupy the main track while working. In both areas, capacity approaches zero while trains are performing this work. (See Figure 3.2, Location 15 and 41.)

Seattle (South Portal) – Everett (PA Junction)

South Portal-MP 8 (Ballard)

The speed limit in the tunnel between South Portal and North Portal is 20 mph. There are no intermediate signals between South Portal and North Portal resulting in a signal block length of about 1.6 miles. While this speed and distance provide capacity similar to most of the line between Seattle and Portland, it can be a limitation for the aggregate of Seattle-Everett, Portland-Seattle, and Seattle Terminal non-train movements (e.g., transfers, locomotive movements) that use this segment.

The signal block between South Portal and North Portal also imposes an additional constraint. Generally, a yellow signal (proceed not exceeding 35 mph prepared to stop at the next signal) will not be a capacity limitation on track with a 20 mph speed limit. The speed is sufficiently low to allow the locomotive engineer to observe that the next signal is not indicating stop (because the train ahead is still moving and already has left the block ahead) before taking action to stop the train (often irreversible in freight train operation). However, the curvature of the track in the King Street tunnel and the combination of curvature and structures north of the tunnel limit sight distance to the degree that freight trains may need to stop for signals that already have changed to an indication that does not require a stop.

There are two segments of single track operation. The longer one, between Galer Street and MP 5.4, poses a significant capacity limitation of 48 trains per day. There is a minimum delay of 17 minutes at Galer Street when the line is operating at capacity.

The Ballard Bridge is open for marine navigation an aggregate of 40 trains of capacity per day. Capacity also is restricted by the 20 mph speed restriction across the bridge. (See Figure 3.2, Location 16 and 45.)

Edmonds

Single track between MP 16 and MP 18 has a capacity of 144 trains per day. This is greater than the limiting capacity of the Seattle-Everett route; however, a minimum delay of three minutes occurs here when the line is operating at capacity because of the configuration of the single and double track segments. (See Figure 3.2, Location 18.)

Mukilteo

Single track between MP 27 and MP 28 has a capacity of 288 trains per day, greater than the limiting capacity of the Seattle-Everett route. As currently configured, when the Seattle-Everett route is operating at capacity, no delay occurs because of this section of single track. (See Figure 3.2, Location 20.)

Maintenance Access Interbay-Everett Junction

This segment of track has limited roadway access requiring maintenance of way vehicles to occupy one of the two main tracks in this segment for its entire length when performing maintenance, occupying as much as 34 percent of the capacity of the line. (See Figure 3.2, Locations 17 and 19.)

Single Track Operation Interbay-Everett Junction

When overtaking is necessary on this segment, it requires one double track segment and both adjoining single track segments. Depending upon the exact traffic arrangement, such an overtaking movement may be made without significant loss of capacity if the trains are (due to the pattern of occupied and unoccupied track that occurs when traffic on the line is at capacity); however, the delay involved may be extensive. (See Figure 3.2, Locations 17, 18, 19, and 20.)

Everett (Everett Junction-PA Junction)

The 2.5 miles of single track between PA Junction and Everett Junction is the capacity limitation of the Seattle-Everett route, due to its length and 25 mph speed limit. This limitation does not apply to traffic entering and leaving the line at Everett Junction for movement by way of the Bayside Yard route. The aggregate of the traffic of the two routes is limited by the single track segment at Interbay. (See Figure 3.2, Location 21.)

Everett (PA Junction)-New Westminster, British Columbia

PA Junction-Delta Junction

The line between Everett Junction (Seattle-Everett route) and GN Junction (the entrance to Delta Yard) has a capacity of 24 TPD because of low-speed (15 to 25 mph) operations over 4.2 miles of single track.

The hand throw switches at Delta yard and the need to double trains together on the main line when leaving the yard further reduces capacity on this segment of track. The movement of a single train from the time it occupies the main track at GN Junction until the time it clears the single track segment at Everett Junction can be one hour, each train occupying the capacity equivalent of at least two trains.

Main line capacity north of Delta Yard is further limited by 15 mph speed restriction around the curve at Delta Junction and a 10 mph speed restriction across Snohomish River Bridge just north of Delta Junction. The capacity on the main line past Delta Yard is limited to 14 through trains per day. The yard can originate or depart an additional 16 TPD. (See Figure 3.2, Locations 22 and 46.)

Marysville

The 20 mph speed limit for freight trains on the Steamboat Slough and Ebey Slough bridges south of Marysville limits the capacity on the line to 24 TPD. (See Figure 3.2, Location 23.)

English-Bow

The capacity of this segment is 48 trains per day, affected by the running time between the sidings at Mt. Vernon and Bow, if the trains involved fit in the siding at Stanwood and Mt. Vernon. However, typical trains are longer than the sidings at Stanwood and Mt. Vernon, making the capacity limitation 16 trains per day between Bow and English. (See Figure 3.2, Location 24.)

Bow-Swift

The capacity of this segment is 14.4 trains per day, affected by the running time between the sidings at Bow and Ferndale. The South Bellingham siding is generally too short to accommodate most of the trains that use this line. (See Figure 3.2, Location 25.)

Swift-CN Thornton Yard (Surrey, British Columbia)

The capacity between Swift and Thornton Yard (the northern origin and destination of most freight traffic on the Everett-New Westminster route) is affected by running time between meeting points (the siding at Swift and Thornton Yard) and by U.S. and Canada customs procedures. If trains run between Swift and Thornton Yard unaffected by customs procedures, capacity is 12 trains per day, significantly affected by the 5 mph speed limit for southward trains north of Swift (for movement though the VACIS), the 21 mph speed limit at White Rock, and the 15 mph speed limit on the Nicomekl River bridge. (See Figure 3.2, Location 26.)

U.S. Customs inspects southward trains at Swift. The duration of the inspection may affect the capacity in either direction because the meeting point may not be available for a subsequent pair of trains, therefore reducing capacity.

Northward trains stop at Swift to close and seal the doors of all empty cars. If the duration of this activity is similar to that of the U.S. customs inspection of the southward train on the siding, there is no capacity effect. Canada customs periodically stops northward trains at White Rock for further inspection. When that occurs, capacity is reduced by the stopped train. If each northward train is stopped by Canada Customs, the capacity is reduced to eight trains per day.

The Amtrak *Cascades* trains are the only traffic on the line that does not stop for border inspection at Swift.

The Everett-New Westminster route and the BC Rail Langley-Roberts Bank/Deltaport route cross at Colebrook. Theoretically, the capacity limitation on the Everett-Thornton route makes traffic so infrequent that traffic on the BC Rail line should be of almost no concern. Traffic on the two routes is not synchronized (which would be impractical if not impossible). Traffic is controlled by BC Rail, with virtually no consideration being given to the effect of BC Rail movement on the Everett-New Westminster route. The joint section of track is allocated to traffic on the BC Rail route as much as 30 minutes in advance. If this occurs during the approximately one-hour interval between Everett-New Westminster route trains that is normal when the line is operating at capacity, there is no effect. Should one of these movements conflict with Everett-New Westminster route traffic, the capacity limiting effect can be substantial.

Vancouver-Pasco

The capacity imitations on this line (in addition to the lengthy running time between some of the sidings; see Figure 3.2, Locations 27 and 28) include openings of the Columbia River drawbridge, trains from Pasco en route stations north of Vancouver stopping to change crew, and the low-speed movement to and from Vancouver Yard, the Port of Vancouver, and the Portland-Seattle route. (See Figure 3.2, Locations 1, 2, and 37.)

Auburn-Pasco

The running time between the Lester siding and the double track segment at Easton is the capacity limit on the Auburn-Pasco route (see Figure 3.2, Location 29); however, there are other significant factors. Between Ellensburg and Pasco, the capacity limiting running time is between the sidings at Pomona and Ellensburg, giving a 12 trains per day capacity. Were that improved, the next limiting running time would be between Toppenish and Byron, limiting capacity to 17 trains per day.

In addition, the form-based traffic control system imposes an additional capacity limiting factor. When the line is at capacity, it would be necessary for the train dispatcher to issue four separate verbal/written train movement authorities almost simultaneously because at full capacity, two meets happen simultaneously, at distant points on the route each time there is an encounter between trains. The nature of the form-based traffic control safety procedures could cause significant delay to at least one of the trains involved, reducing capacity from that determined by running time between sidings.

Everett-Spokane

The significant capacity limitation is the running times between the Skykomish, Scenic, and Berne sidings and between the Leavenworth and Winton sidings, as discussed earlier (see Figure 3.2, Location 31). Were the line to be operated in one direction (westward) only, for example as one of two one-way routes acting as double track between Seattle and

Spokane, capacity would be limited by the current configuration of the Cascade Tunnel. Although the tunnel ventilation time between westward trains would be a factor to a relatively small degree, the approximately 30-minute running time through the tunnel would limit capacity to 24 trains per day. For safety reasons, only one train is allowed to occupy the tunnel at a time. There are tunnels throughout the world, some of which are in the United States, than can be occupied by more than one train simultaneously. However, such an arrangement for the Cascade Tunnel would involve a different signal system and electrification,.

Capacity also can be affected by the relatively short sidings east of Wenatchee at Lyons, Espanola, and Edwall, all less than 8,000 feet long. When trains of more than 7,400 feet are considered, the capacity between Bluestem and Latah Junction is 24 trains per day. For trains of over 7,500 feet, the capacity is 18 trains per day. (See Figure 3.2, Location 32.)

Pasco-Spokane

The single track segment between Connell and Cunningham has the longest single track running time on this route, and thus is the capacity limiting segment. (See Figure 3.2, Location 33.)

Spokane – Athol, Idaho

Two sections of single track running time between Irvin (Spokane) and Otis Orchards (10 miles west of Hauser, Idaho; 4.1 miles) and between Rathdrum, Idaho, and Athol, Idaho, (11 miles) have the longest single track running times on this route, and thus are the capacity limiting segments. The Irvin to Otis Orchards segment includes a single track bridge over the Spokane River. As Hauser, Idaho, is the crew change and mainline fueling point for through trains which pick up and set out cars in Spokane, adequate mainline capacity between Spokane and Hauser is very important. (See Figure 3.2, Location 34.)

Primary Rail Terminals and Yards

BNSF

Utilizing terminal performance data provided by BNSF and assuming daily average inventory exceeding 80 percent of the Performance Degradation Point or 80 percent the following BNSF yards and terminals are considered to be operating at or over capacity:

- Arco;
- Centralia;
- Everett;
- Interbay;
- Longview Junction;

- Pasco;
- Seattle;
- Spokane;
- Tacoma;
- Vancouver; and
- Wishram.

The common reasons for these terminals being over capacity:

- Inefficient mainline access – Arrival/Departure tracks are either not available or are too short to hold an entire train. This requires doubling trains entering and leaving at virtually all of them.
- Shortage of locomotives for outbound trains.
- Shortage of crews for outbound trains.
- Inbound trains not on time or inbound trains bunched together.

UPRR

UPRR Argo Yard (Seattle) is over capacity because it is used for both domestic and international intermodal traffic, solid waste, and general merchandise. The mainline connection is located so close to the throat of Argo Yard that virtually all switching must be done from the west end, which conflicts with unit trains arriving to or departing from the Port of Seattle Terminal 5 on-dock intermodal facility. (See Figure 3.2, Locations 42 and 43.)

Tacoma Rail

Tacoma Rail's Tacoma Rail Yard tracks are consistently over 60 percent utilized and often times 80 percent utilized, resulting in operational inefficiency and significant delays. (See Figure 3.2, Location 40.)

Commuter and Intercity Passenger

There are two capacity limitations that affect passenger trains exclusively. The first is the limitation imposed by passenger-exclusive infrastructure. The second is the limitation imposed by the time-sensitive nature of passenger traffic. This limitation has a double effect. First, relatively small capacity limitations can have a significant effect because of the commercial capacity requirement.

In general, the capacity for a given segment of line can be much higher for passenger trains than for freight trains. Passenger trains are not as long as freight trains, are faster than freight trains, and have a much shorter braking distance than freight trains. When passenger trains are mixed with freight trains, the signal system must be configured to take advantage of the differences in order to make use of the capacity benefit. There is no capacity benefit if the signal system keeps passenger trains that can stop in 4,000 feet two miles apart as it does freight trains.

Often, operation at capacity involves some amount of minimum delay. Minimum delay is generally not important to freight traffic, but traffic that requires the shortest possible running time, such as passenger trains and some domestic intermodal traffic, is limited to the capacity that is available without delay. This can be significantly less than the capacity of the line. When the limitations of the typical single track operation between Portland and Vancouver, Woodland and Castle Rock, Ruston and 21st Street (because of freight traffic congestion) and the physical single track operation in the Nelson Bennett and Ruston tunnels, at Tacoma, and at King Street Station are combined, capacity is limited.

The need to operate passenger trains (and some intermodal trains) without delay aggravates capacity limitations for other trains. For example, freight trains that do not need to stop in the Kalama-Rocky Point area (north of Vancouver) are regularly delayed by congestion caused by the trains that must stop exceeding the capacity for such traffic. When a passenger train (which is more time-sensitive than the freight train) approaches, the passenger train delays freight traffic that need not stop. The capacity limitation that is delaying the freight trains for the passenger trains is related to the stopped freight trains rather than to the passenger train. Were the trains that cannot be accommodated at Kalama, Longview Junction and Rocky Point not standing on the main tracks waiting, the passenger train and the other freight trains could be accommodated. Often, the nature of a "passenger-related" capacity improvement is an improvement in freight trains so that they can be accommodated clear of the main tracks. The alternative would be the provision of a separate track for passenger train operation, bypassing the capacity limitations associated with freight operation altogether.

Portland

Portland Union Station is generally adequate for current and planned service; however, there are several limitations. (See Figure 3.2, Location 1.)

Speed – The speed limit on the Steel Bridge, immediately south of the station, is six mph. The six mph speed limit continues through the station to the north end. The six mph speed limit has a direct effect on capacity. There are two elements to the effect. First, there is a very large speed differential between freight trains and passenger trains, significantly increasing the minimum headway between a freight train and a following passenger train. Second, when all traffic is moving at the same speed, the capacity limitation of low speed can be mitigated by block length. This is only effective if the speed is great enough to allow a consistent minimum headway. At six mph, signals must be very closely spaced to allow a minimum headway that is consistent with the minimum headway possible between Portland and Vancouver.

There are two tracks that pass through the station and are operated as main tracks at either end, but they are operated as yard tracks through the station. Trains operate at restricted speed, which is a speed not exceeding 20 mph but prepared to stop within half the range of vision. Depending upon the weight of the train and the visibility conditions (e.g., weather, obstructions), restricted speed can be a speed much less then 20 mph. This condition does not directly affect capacity for passenger operations; however, it has an effect on capacity when a freight train passes through the station, aggravating the effect of the six mph speed limit on the Steel Bridge.

Track Configuration – The track configuration is generally adequate for the current and planned traffic; however, it must be utilized carefully to ensure consistency with the requirements of current and future passenger operations. Only two of the tracks (numbers four and five) can be approached and entered at normal speed. Tracks two and three connect to track four through a turnout with a 10 mph speed limit. Also, simultaneous arrival and departure can only occur on one pair of tracks, which must always include track five. Tracks four and five also are the tracks that pass through the station and would be main tracks if signaled. Thus, there is potential conflict between passenger and freight trains, depending upon the traffic situation. This effect is aggravated by the low speed limit for freight trains.

Signal System – There is no signal system on the tracks through Portland Union Station. The Union Pacific CTC traffic control system extends south from (and including) the south end of the station. The BNSF traffic control system extends north from a point north of the north end of the station.

Vancouver, Washington

The Vancouver station has only east side and center platforms. This limits capacity in either of two ways. Traffic must be arranged such that all passengers use the east track at Vancouver or passenger trains stopping at Vancouver occupy both tracks (one with the train and one with the passengers crossing to the between tracks platform from the east side of the line). Depending upon the traffic situation, operation of a southward passenger train on the east main track between Vancouver and North Portland Junction (the nearest crossovers) can result in some period of single track operation, which reduces capacity. (See Figure 3.2, Locations 1 and 2.)

Kelso

The Kelso station has only east side and center platforms. This limits capacity in either of two ways. Traffic must be arranged such that all passengers use the east track at Kelso or passenger trains stopping at Kelso occupy both tracks (one with the train and one with the passengers crossing to the between tracks platform from the east side of the line). Depending upon the traffic situation, operation of a southward passenger train on the east main track between Ostrander and Kelso South (the nearest crossovers) can result in some period of single track operation, which reduces capacity. (See Figure 3.2, Location 4.)

Centralia

The Centralia station has only west side and center platforms. This limits capacity in either of two ways. Traffic must be arranged such that all passengers use the west track at Centralia or passenger trains stopping at Centralia occupy both tracks (one with the train and one with the passengers crossing to the between tracks platform from the east side of the line). Depending upon the traffic situation, operation of a northward passenger train on the west main track between Wabash and Centralia South (the nearest crossovers) can result in some period of single track operation, which reduces capacity. (See Figure 3.2, Location 7.)

Centennial

The Centennial station has only east side and center platforms. This limits capacity in either of two ways. Traffic must be arranged such that all passengers use the east track at Centennial or passenger trains stopping at Centennial occupy both tracks (one with the train and one with the passengers crossing to the between tracks platform from the east side of the line). Depending upon the traffic situation, operation of a southward passenger train on the east main track between Nisqually and Plumb (the nearest crossovers) can result in some period of single track operation, which reduces capacity. (See Figure 3.2, Location 8.)

Tacoma

Amtrak Station – The Tacoma Amtrak station is located on a single track east of the main tracks between D Street and River Street. Single track operation of the station extends between 21st Street and River Street, the nearest crossovers. The capacity limitation of the 1.2 miles of single track operation on which there is a station stop of several minutes is aggravated by the speed limit of 10 to 20 mph over the length of this segment. (See Figure 3.2, Location 10.)

Tacoma Rail/Tacoma Dome Station – The Tacoma Rail line between TR Junction (the connection with BNSF) and the Tacoma Dome Station is single track except for a section of double track approximately 1,700 feet long between Portland Avenue and L Street. The speed limit is 30 mph for passenger trains (except 10 mph over switches at Portland Avenue, L Street, and G Street) and 10 mph for freight trains. (See Figure 3.2, Location 10.)

Seattle

King Street Station has three through tracks (connected to the main tracks at both ends) and four stub tracks (connected to the main tracks only at the south end). Two of the three through tracks are configured for Sound Transit use. Use by Amtrak trains is not practical because the narrow platform is occupied by fixed obstructions (such as stairs and elevators) that prevent the operation of motor vehicles needed to supply and service Amtrak trains. Thus, Amtrak trains to and from north of Seattle must share a single track in the station. Depending upon the nature of the train occupancy (e.g., arriving, leaving, long-distance, corridor), trains may be limited to two per hour or less.

The north end of the station is configured for the operation of two Sound Transit trains simultaneously. The track used by Amtrak trains connects only to one of the two main tracks. Northward Amtrak trains must operate on the normally southward main track through the King Street tunnel. Depending upon the traffic situation, this can cause the same single track capacity limitation on the two main tracks as any other situation in which both tracks are used in the same direction or in which one track is out of service.

There is a short segment of single track operation at the south end of the station. Simultaneous movements between the main tracks and the station are not possible. The hand throw switches on the south end of the station extend the time needed for movement on the single track segment. Each movement requires about five minutes, or 12 trains per hour. The movements affected include passenger trains (Sound Transit and Amtrak), passenger equipment moving between the station and the maintenance facility (Sound Transit and Amtrak), and freight trains.

The route between the station and the maintenance facility is a second segment of single track operation. This segment also has a capacity of about 12 trains per hour. The location of the maintenance facility on the opposite side of the main tracks from the station exacerbates the effect of the capacity limitation because this route includes movement on both main tracks. (See Figure 3.2, Locations 14 and 16.)

Everett

Passengers walking between the station and the platform used by Amtrak trains must cross the track used by Sound Transit trains. Effectively, each Sound Transit train arriving and leaving uses the Sound Transit track and the main track when considering passenger train capacity. (See Figure 3.2, Location 21.)

Vancouver, British Columbia

Only one track in Pacific Central Station can accommodate an Amtrak Cascades Train. Train size is limited to the length of the current Talgo trains in this service by the length of the enclosed area needed for customs and immigration processing. (See Figure 3.2, Location 26.)

■ Descriptions of Identified Washington State Yards and Terminals Rail Constraints

BNSF Vancouver Yard

Interviewed: Daryl Ness, Terminal Superintendent
Telephone: (360) 418-6377
Date: 4/18/06

Summary

Vancouver Yard is a flat switching yard responsible for classifying cars to/from Pasco, California, UPRR, Interbay, Everett, and various locals. The average dwell is 24 hours which is consistent with only having a single outbound train for a block (destination). The dwell time increases quickly when the daily yard inventory exceeds 750 cars. Yard operations conflict with other mainline operations and are further impacted by existing infrastructure constraints. Mainline operations through Vancouver Yard total 70 to 75 trains per day. These trains include general merchandise, intermodal, unit trains (grain), UPRR interchange, and Amtrak. Flat switching is done from both ends of the yard, with a restriction of 12 cars at the south end because of the mainline operations. The primary infrastructure constraint is the 10 mph single mainline track connecting the Fallbridge and Seattle Subdivisions. This configuration reduces the mainline throughput and because of the yard, lead, and mainline conflicts consumes mainline capacity whenever trains depart from the yard or United Grain. The time-sensitive schedule for Amtrak also causes certain yard operations to periodically stop throughout the day for Amtrak trains.

Measures

- Daily yard capacity (inventory) up to 750 cars switched is comfortable
- Over 750 cars terminal is pushing limits
- Average dwell is 24 hours
- When daily yard capacity exceeds 750 cars the dwell will increase to 40 hours.

Classification Tracks

- 17 tracks – track centers too close for Carmen to work between

R&D Tracks

- 6 – Carmen can work between the tracks

Blocks (Destinations)

- Only one outlet per train for each block

Trains – Spread out over 24 hours

- Pasco daily
- Interbay daily
- California (Barstow) daily
- Everett to Vancouver daily
- Camas Local daily
- Albany daily
- Transfer from Portland, 100 cars per day

- UPRR Interchange, 100 cars per day
- Passenger Trains

Switching Operation

- Flat switching from both ends
- 12-car lead on the south end
- 20- to 25-car lead on the north end

General Information

- Pasco provides blocks for the entire terminal
- 70 to 75 trains per day through Vancouver

Needs/Issues

- Wider track centers in the yard for Mechanical Department to work. However, not worth the loss of tracks.
- Available power for outbound trains
- Available crews are not a problem
- 10 mph single mainline track connecting the Fallbridge and Seattle Subs the biggest problem:
  - Main problem is departing outbound trains out of B Yard or United Grain
  - Doubling trains together on mainline takes 30 to 60 minutes

BNSF Spokane Yard

Interviewed: Maxine Timberman, Terminal Superintendent
Telephone: (509) 536-2224
Date: 4/18/06

Summary

Spokane Yard is a flat switching yard responsible for classifying cars for trains going east, west, and south, as well as various locals. The average daily capacity is 1,000 to 1,200 cars, with an average dwell of 27 hours. The terminal is considered critical when it exceeds 1,300 cars. The yard is made of three main yards: Erie Street; Hauser, Idaho; and Yardley. Erie Street Yard is used primarily for grain trains or UPRR interchange. Hauser Yard is used primarily for limited intermodal pick-up/set out, grain storage, 1,000-mile inspection, adding distributed power, and crew changes. Yardley Yard is split between two smaller yards. The "hell hole" is made up of 17 short tracks where most of the small blocks are built. The larger yard is located next to the mainline and used for larger blocks and for setting out, picking up, and building trains. When the yard is full the mainline is used for building outbound trains. Picking up blocks for outbound trains usually requires the train be entirely reswitched when it contains multiple blocks. This reswitching can take as long as five hours to complete. Since this is not primarily an origin/destination point the biggest constraint to maintaining a fluid yard is having inbound trains and power arrive on time. Also, due to the fact that the crew change point for the trains through Spokane is at Hauser, Idaho, 24 miles away, the mainline capacity between Spokane and Hauser is critical. Mainline capacity between Spokane and Athol was identified as being critical to Spokane Yard. Currently, approximately half of the 42 miles are double track and half single track.

Measures

- Daily yard capacity (inventory) average 1,000 to 1,200 cars switched okay
- Over 1,300 cars terminal is hurting
- Average dwell is 27 hours

Yards

- Erie Street – Primarily for UPRR interchange, staging, and pickup/setout of grain trains
- Yardley – Primarily for classification
- Hauser – Some intermodal pick up/set out, grain storage, 1,000-mile inspection, add distributed power

Classification Tracks

- "Hell Hole" – 17 tracks average 1,500 feet
- Long – 12 tracks average 3,200 feet – 5 longest tracks used for R&D/Pickup and Setout

Blocks (Destinations)

- 10 outbound blocks – built in the "Hell hole" tracks
  - 4 industry jobs
  - Pasco
  - Laurel
  - Everett
  - Galesburg

Trains – Spread out over 24 Hours

- Outbound
  - 4 general merchandise originate from Spokane – 3 to 4 blocks each
  - 1 train goes north
  - 3 trains go west
  - 0 trains go east
  - Westbound trains – intermodal primarily via Wenatchee, general merchandise and grain via Pasco
- Pick Up/Setout Trains
  - 5 to 6 general merchandise trains per day
    - Pasco to Conway (Pittsburgh, Pennsylvania)
      - Galesburg block
    - Pasco to Ft Worth, Texas
      - Laurel and Missoula block
    - Pasco to Dilworth, Minnesota
      - Shelby, Northtown, Whitefish block
    - These trains require trains be reswitched to put pickups in the train blocked.
    - 5 hours in schedule for reswitching of Pasco to Dilworth train
    - If road crews have time in their hours of service they will spot the setouts and take a train to Hauser for crew change. When inbound crew reach hours of service switch crew needs
  - 2 intermodal trains per day
- Through Trains/Day
  - 50 – Merchandise, intermodal, grain, Amtrak
  - General merchandise

Switching Operation

- Flat switching from both ends
  - 80 percent from west end
  - East end for big cuts – Pasco, Everett, Galesburg
- 12 car lead on the south end
- 20 to 25 car lead on the north end

Needs/Issues

- Available power for outbound trains
- Trains on schedule
  - When off schedule the plan for the yard is off, dwell time increases, and congestion increases. When yard is full, trains set out and pick up on the mainline instead of long receiving and departing (R&D) track, which reduces mainline capacity.
- When Pasco has a "meltdown," Spokane has to take on classification responsibilities.
- Mainline capacity tied to yard capacity. The two biggest mainline capacity constraints for Spokane which would improve velocity are:
  - Single track between Otis Orchards and Irvin, which includes the single-track Spokane River Bridge
  - Single track east of Hauser, Idaho (Rathdrum to Athol)

BNSF Delta Yard (Everett)

Interviewed: Stu Gordon, Terminal Manager
Telephone: (425) 304-6646
Date: 4/18/06

Summary

Delta Yard is a flat switching yard responsible for classifying cars for 12 outbound trains as well as various locals. The average daily capacity is 800 cars with an average dwell of 28 to 29 hours. The terminal is considered critical when it exceeds 850 cars. The yard is a "belt pack" operation using remote control locomotives, which limits the cuts of cars to be switched to 15 cars. The yard is made up of 13 tracks, which are used for classification and receiving/departing. The biggest issue at Delta Yard is the downtime for Passenger Train (Sound Transit and Amtrak) windows. Having six 7,000-foot R&D tracks and 14 additional classification tracks would provide additional future capacity and fluidity. The WSDOT High-Speed Rail Corridor project, which realigns the Rogers Main to connect with the Bayside Line, would reduce conflict with through trains waiting for commuter windows and a slot through the Everett tunnel.

Measures

- Daily yard capacity (inventory) average 800 cars
- Goes from green to yellow at 750 cars
- Goes from yellow to red at 850 cars

- Average dwell is 28 to 29 hours
- When red average dwell is 35 hours

Yard Tracks

- 13 – Classification, R&D
- No dedicated R&D tracks

Blocks (Destinations)

- 15 outbound blocks

Trains

- All general merchandise
- No intermodal
- Average inbound trains daily: 12
- Average outbound trains daily: 12
  - Every outbound train built out of the Classification Yard

Switching Operation

- Flat switching from both ends
  - Primarily north (railroad west) end
  - Secondarily south (railroad east) end
- Belt pack operation which has tonnage limits – usually 15 cars maximum in a cut

Needs/Issues

- Getting out of the way for Sound Transit and Amtrak
- Windows
  - Bellingham Subdivision 4 times per day
  - Scenic Subdivision 4 Sound Transit and 2 Amtrak per day
  - No trains
    - 5:30 a.m. to 9:00 a.m.
    - 5:00 p.m. to 6:30 p.m.
    - 8:30 p.m. to 9:30 p.m.

- Available power for outbound trains
- Trains on schedule
  - When trains are off schedule, the plan for the yard is impacted, dwell time increases, and congestion increases. When the yard is full then trains set out and pick up on the mainline instead of long R&D track. This reduces mainline capacity.
- Suggested Improvements
  - Add 6 R&D tracks 7,000 feet each
  - Expand yard
    - Add 14 Classification Tracks
  - Add CTC from PA Junction to Delta Junction
  - Reconfigure Rogers Main to allow trains to operate via the Bayside Spur and bypass the Everett tunnel. This project is a part of the WSDOT High-Speed Rail Program.

BNSF Pasco Yard

Interviewed: J.T. Labberton, Terminal Manager
Telephone: (509) 546-3219
Date: 4/18/06

Summary

Pasco Yard is a directional hump yard responsible for classifying 41 blocks, arriving 15 trains per day, and departing 14 trains per day. The average volume of cars processed per day is 1,500 to 1,600. The average in-yard inventory is 2,000 cars with an average dwell time of 29 to 30 hours. The major issues with yard capacity are on-time trains and power availability.

Measures

- Processed average cars 1,500 to 1,600 per day
- Average in-yard inventory of 2,000 cars per day
- Average dwell – measure of how long in terminal
  - Goal 22 hours
  - Average 29 to 30 hours

Yard Tracks

- 47 – Bowl tracks
  - 3 longest tracks holds 26, 60-foot cars (1,560 feet)
  - Shortest tracks 1,160 feet
- R&D tracks
  - 9 Departure
  - 10 Arrival

Blocks (Destinations)

- 41 outbound blocks – 14 take more than one track

Trains

- Average inbound trains daily: 15
  - via Yakima Valley Subdivision: 2 to 5 per day
  - via Fallbridge Subdivision: 10 to 30 per day
  - via Lakeside Subdivision: 10 to 25 per day
- Average outbound trains daily: 14
  - via Stampede Pass: 5 per day 5 days per week, 6 per day 3 days week
  - via Fallbridge Subdivision: 10 to 30 per day
  - via Lakeside Subdivision: 10 to 25 per day
- Through trains
  - 25 to 30/day: grain, intermodal, Amtrak
- Pasco Industry Jobs – 3
- Locals – 3 (Yakima Valley Sub., Connell, UPRR Interchange)

Switching Operation

- Directional humping by plan
  - Westbound 10 a.m. to 10 p.m.
  - Eastbound 10 p.m. to 10 a.m.

Needs/Issues

- Available power for outbound trains
- Increasing vertical clearance on Stampede Pass will cause increase of traffic through Pasco
- Trains on schedule
  - When off schedule the plan for the yard is off, dwell time increases, congestion increases. When yard is full then trains set out and pick up on the mainline instead of long R&D track. This reduces mainline capacity.

BNSF Seattle Terminal

Interviewed: Tom Martin, Assistant Terminal Manager
Telephone: (206) 272-3663
Date: 4/19/06

Interviewed: Tom Rowley, Terminal Superintendent
Telephone: (206) 272-3719
Date: 4/25/06

Summary

Seattle Terminal is made up of the following yards in the Seattle area:

- Two main yards
  - Interbay/Balmer
  - Stacy Street
- Support yards
  - West Seattle
  - South Seattle
  - Kent

Interbay/Balmer has an old and inefficient mini-hump, so the yard effectively flat-switches to classify cars for trains going north and south. Interbay also supports an adjacent grain elevator in the area.

Stacy Street is located east of the Seattle International Gateway (SIG) international intermodal facility. Stacy Street supports SIG and several local general merchandise customers.

West Seattle does not arrive or depart any trains, but does support Port of Seattle T-5 intermodal terminal and serves local industries in West Seattle and Harbor Island.

South Seattle supports the South Seattle Domestic Intermodal Facility and a couple of general merchandise customers.

Kent does not classify cars but does support general merchandise customers in the Kent Valley and the BNSF auto facility. It is primarily a setout and pick up location.

The biggest issue with yard capacities is not being able to depart trains, usually due to lack of power or crews. Commuter train windows do restrict arrival and departure times.

Measures

- Processed average cars (does not include cars at industries)
  - Interbay – 600 per day
  - Stacy – 550 to 600 per day (includes some intermodal cars)
- Average dwell
  - Interbay – goal 28 hours
  - Stacy – average 27 hours

Yard Tracks

- Interbay
  - 15 classification tracks
  - 15 R&D tracks
- Stacy
  - 18 classification/R&D tracks
  - Multifunctional usage (intermodal and general merchandise)

Blocks (Destinations)

- Interbay
  - 12 outbound blocks
  - Canadian blocks overflow into multiple tracks
- Stacy
  - 5 outbound blocks – Pasco, Tacoma, Kent, Seattle, local

Trains

- Interbay
  - Average inbound trains daily: 7
  - Average outbound trains daily: 0
  - Through trains pick up/set out – 5 total (including 1 vehicle and 2 intermodal trains)
  - 1 industry job to support grain terminal
- Stacy
  - Average inbound trains daily: 3
  - Average outbound trains daily: 3
  - Through trains pick up/set out – 2 (1 merchandise and 1 local). Use Colorado Main or PC tracks
  - 7 industry jobs (4 are for West Seattle and Harbor Island). Support Rabanco Lander Operation
- Other industry jobs
  - South Seattle – 3 jobs 24/7
  - Kent 2 to 6 days per week 24 hours per day jobs
- Locals –
  - a.m. – Maltby Turn – Black River, Renton, Maltby, Snohomish – 6 days week (Serves Rabanco Black River)
  - p.m. – Midnight transfer to Tacoma

Needs/Issues

- Available power for outbound trains
- Commuter windows – BNSF has to schedule a portion of the day to hold train crew calls
- Mariners games impact terminal operations
- Trains on schedule
- Yard fluidity would be improved if processed traffic could be moved out of the terminal and staged for departure.

Tacoma Rail Yard

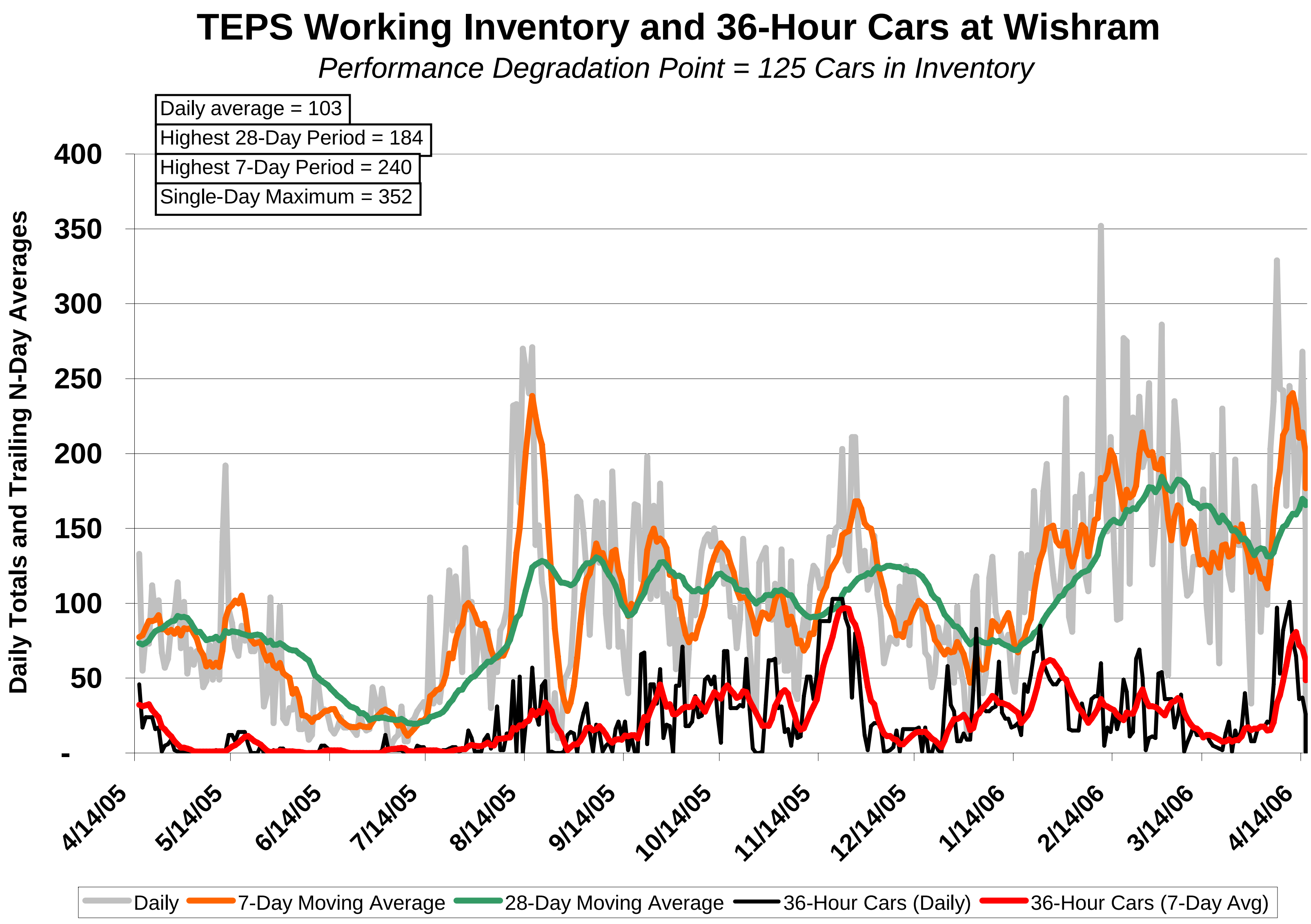
Tacoma Rail monitors infrastructure occupancy within its rail infrastructure. Rail yard space is essential in maintaining a continuous flow of rail traffic without disruption. Uninterrupted flow is when all activities are planned and sequenced to avoid delay. Yard congestion can have a profound impact on these activities.

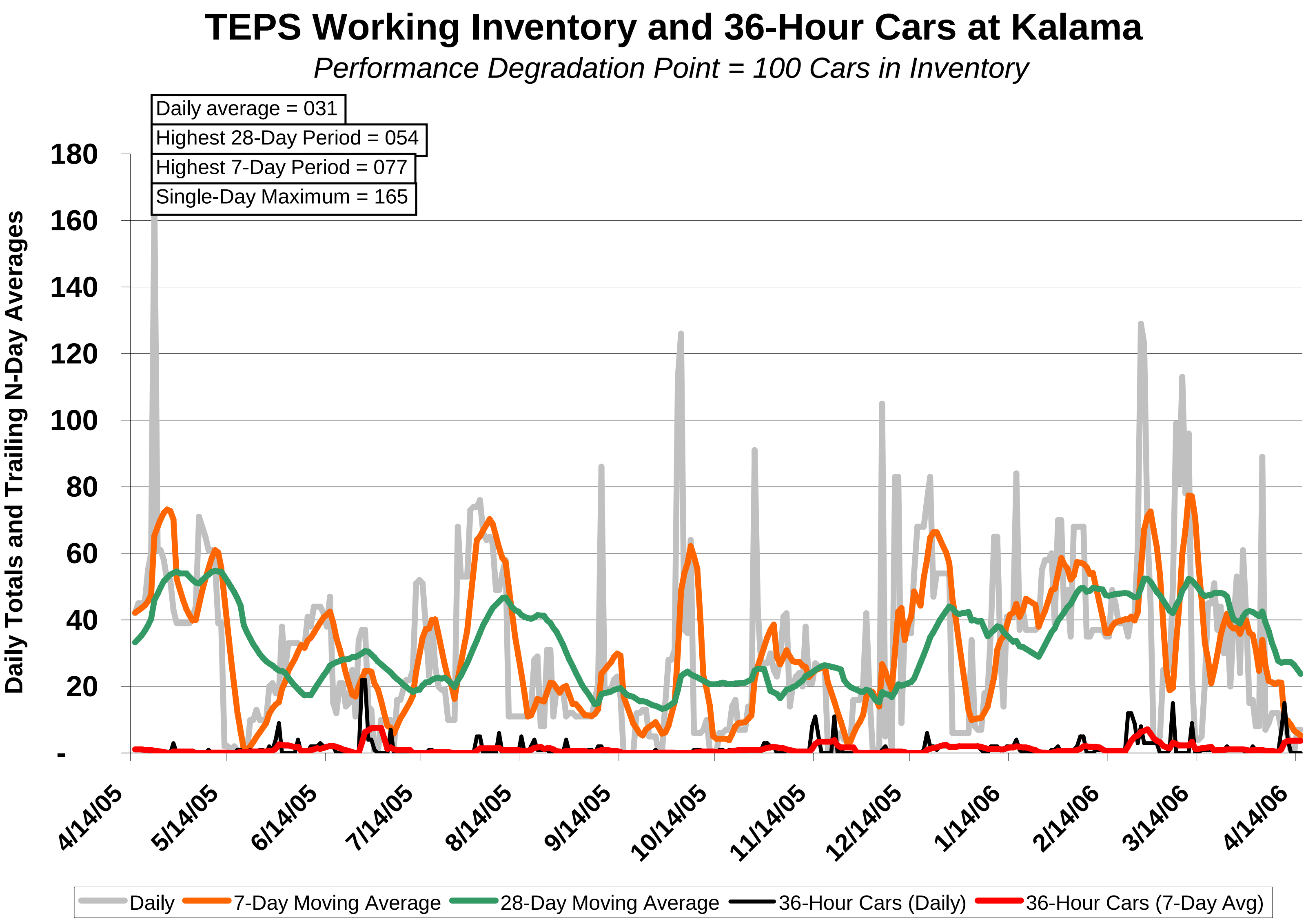
First, Tacoma Rail yards must first be able to receive inbound trains from either of the mainline carriers (UP, BNSF) that serve the Tideflats as they arrive in the Tacoma area. Inbound deliveries can range from 300- to 8,000-foot trains and actual arrival times can vary widely from schedule. If an inbound train cannot be delivered to Tacoma Rail, it may be routed out of the Fife/Tacoma area and may not be available again for up to 24 hours.

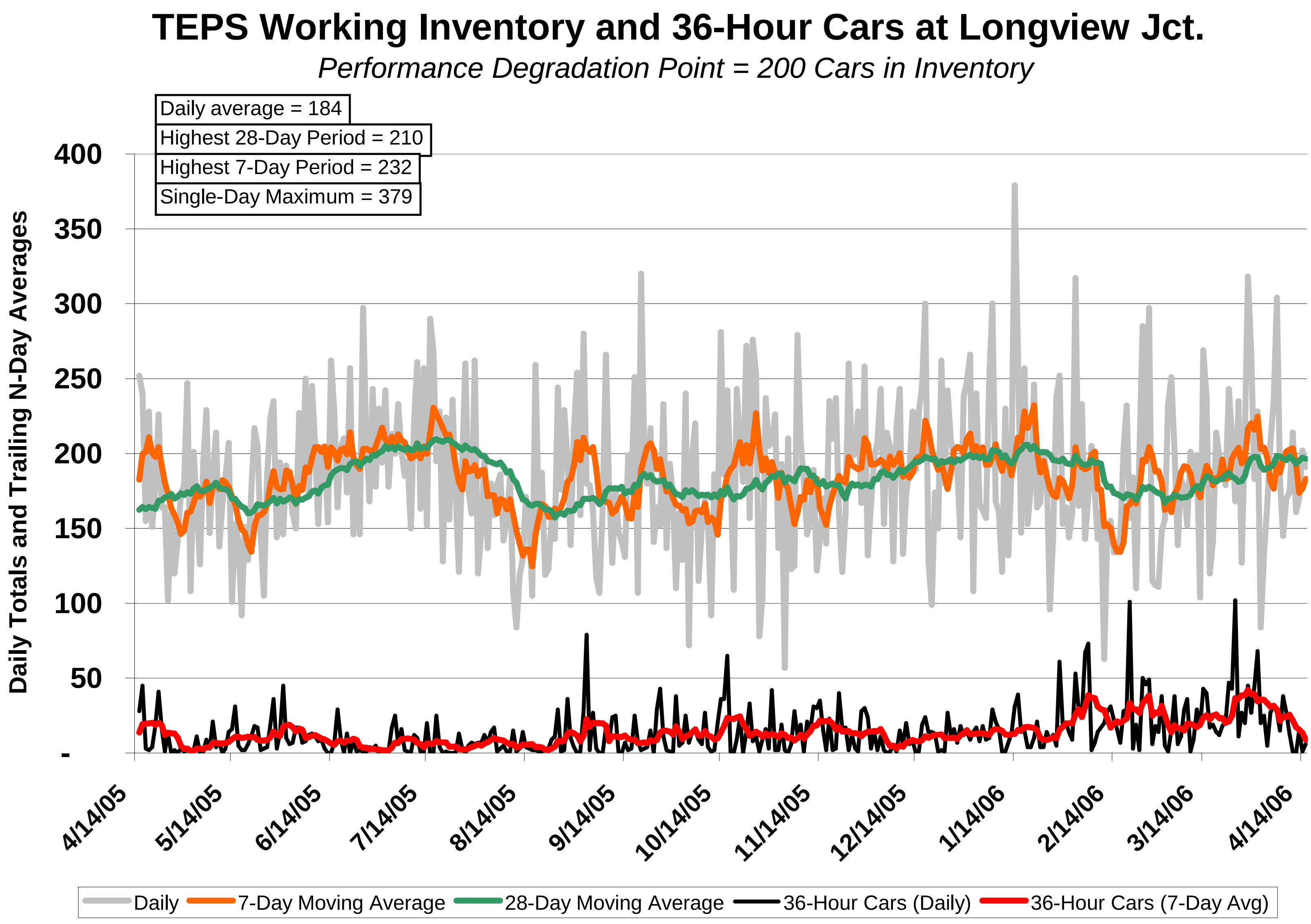
Second, Tacoma Rail yards must have enough room to switch out, stage and position railcars for efficient delivery. Inbound loads are not presorted for destination within the Tideflats. Inbound trains may have mixed loads of commercial and intermodal equipment. The intermodal traffic may be destined to Evergreen, K-Line, Hyundai, or Northwest Container while the commercial traffic could be destined to any number of Tacoma Rail's 60-plus customers. Sorting inbound railcars for internal destinations can be excessively time-consuming and expensive. Staging and support tracks along with a clear switching lead have to be available in order for this sorting to be accomplished efficiently.

Third, Tacoma Rail's staging and support infrastructure must have sufficient room to pull completed trains or empties from its customers. That way, when the pull is completed, the next railcars in the yard can be spotted at a facility.

Tacoma Rail uses a rail industry rule of thumb for infrastructure utilization which states that available track should not be utilized in excess of 60 percent by railcars. Utilization in the range of 50 to 60 percent indicates mild congestion. At that level, there are some restrictions of operations. Ratios in excess of 60 percent indicate significant congestion and reduced responsiveness. At a time of significant utilization, railcars have to be moved and shuffled excessively to make room for other cars while attempting to keep cars in logical sequences. Utilization in excess of 80 percent indicates a yard is in gridlock and all activities are severely delayed.


TEPS Working Inventory and 36-Hour Cars at Wishram
Performance Degradation Point = 125 Cars in Inventory
Daily average = 103
Highest 28-Day Period = 184
Highest 7-Day Period = 240
Single-Day Maximum = 352
Daily Totals and Trailing N-Day Averages
400
350
300
250
200
150
100
50
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)


TEPS Working Inventory and 36-Hour Cars at Kalama
Performance Degradation Point = 100 Cars in Inventory
Daily average = 031
Highest 28-Day Period = 054
Highest 7-Day Period = 077
Single-Day Maximum = 165
Daily Totals and Trailing N-Day Averages
180
160
140
120
100
80
60
40
20
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)


TEPS Working Inventory and 36-Hour Cars at Longview Jct.
Performance Degradation Point = 200 Cars in Inventory
Daily average = 184
Highest 28-Day Period = 210
Highest 7-Day Period = 232
Single-Day Maximum = 379
Daily Totals and Trailing N-Day Averages
400
350
300
250
200
150
100
50
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
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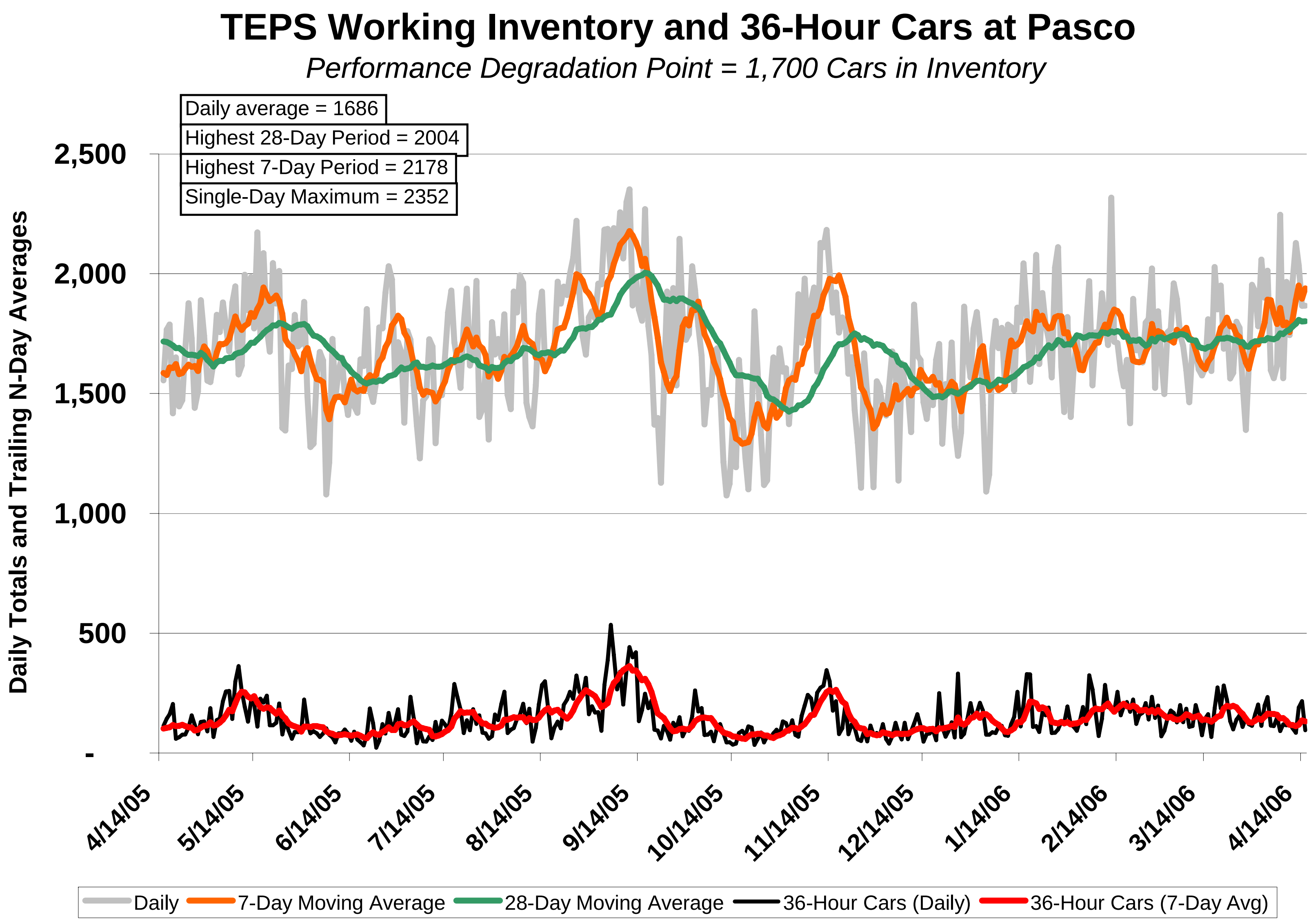
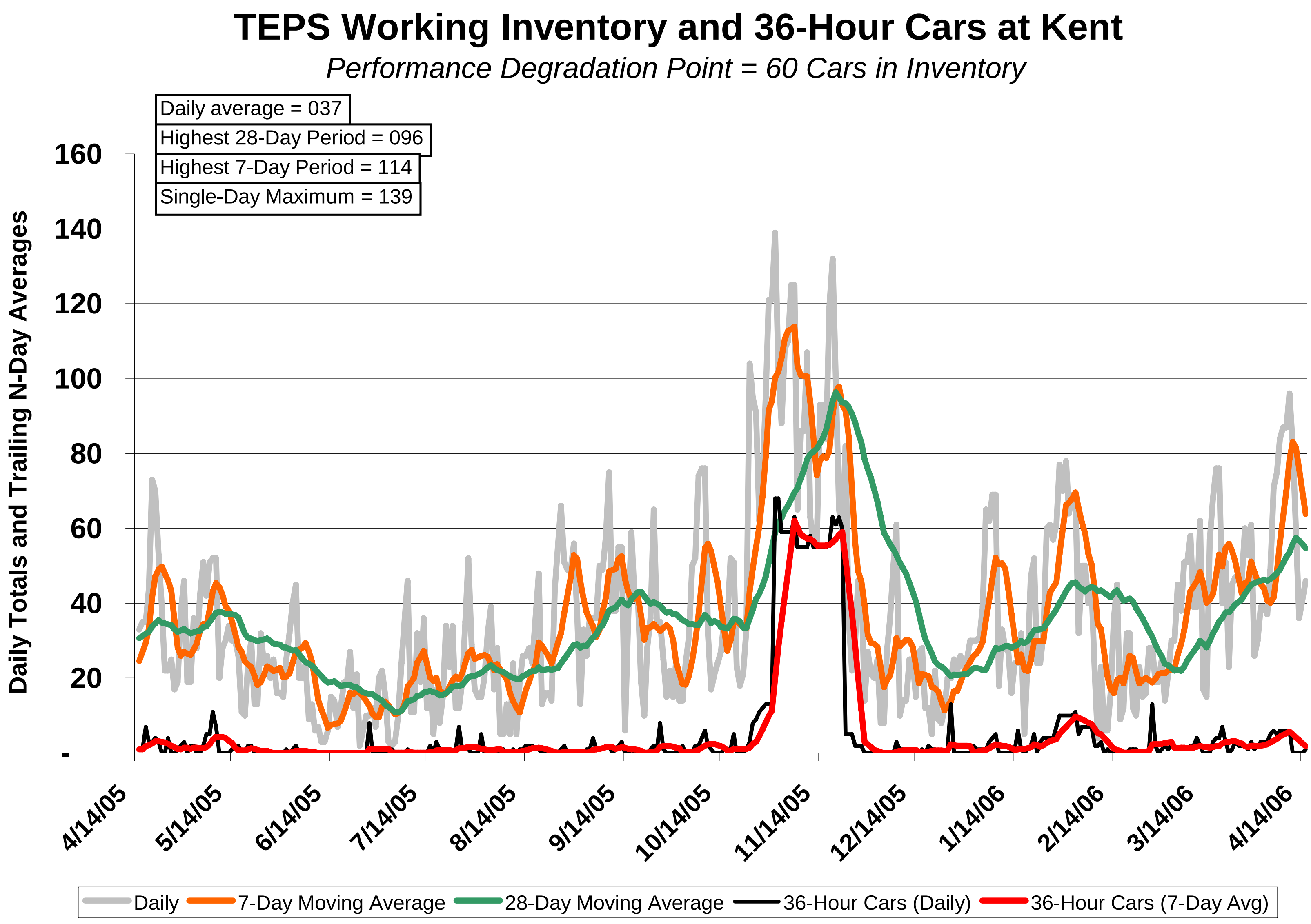
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)


TEPS Working Inventory and 36-Hour Cars at Pasco
Performance Degradation Point = 1,700 Cars in Inventory
Daily average = 1686
Highest 28-Day Period = 2004
Highest 7-Day Period = 2178
Single-Day Maximum = 2352
Daily Totals and Trailing N-Day Averages
2,500
2,000
1,500
1,000
500
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)


TEPS Working Inventory and 36-Hour Cars at Kent
Performance Degradation Point = 60 Cars in Inventory
Daily average = 037
Highest 28-Day Period = 096
Highest 7-Day Period = 114
Single-Day Maximum = 139
Daily Totals and Trailing N-Day Averages
160
140
120
100
80
60
40
20
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
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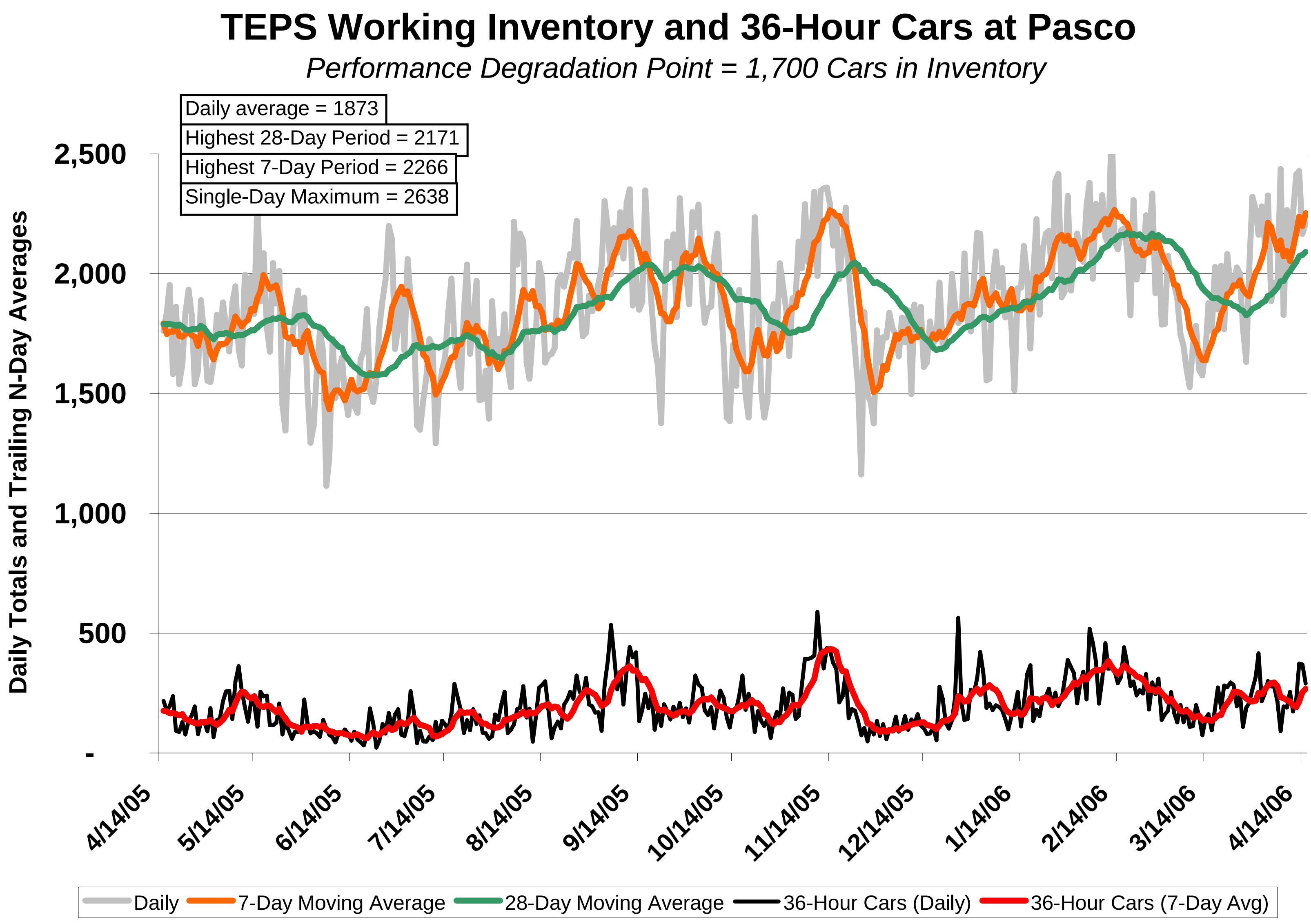
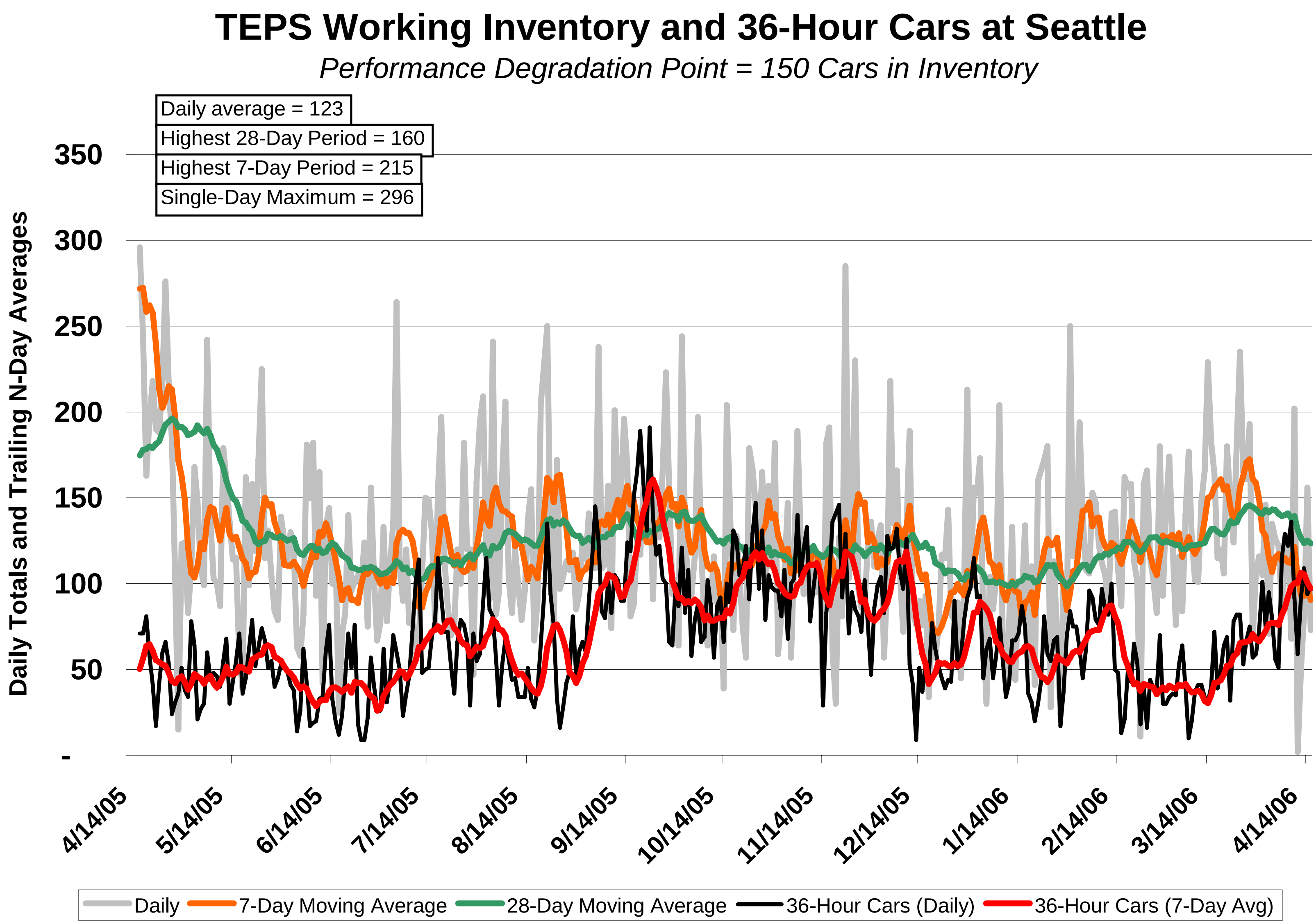
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)


TEPS Working Inventory and 36-Hour Cars at Pasco
Performance Degradation Point = 1,700 Cars in Inventory
Daily average = 1873
Highest 28-Day Period = 2171
Highest 7-Day Period = 2266
Single-Day Maximum = 2638
Daily Totals and Trailing N-Day Averages
2,500
2,000
1,500
1,000
500
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)


TEPS Working Inventory and 36-Hour Cars at Seattle
Performance Degradation Point = 150 Cars in Inventory
Daily average = 123
Highest 28-Day Period = 160
Highest 7-Day Period = 215
Single-Day Maximum = 296
Daily Totals and Trailing N-Day Averages
350
300
250
200
150
100
50
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
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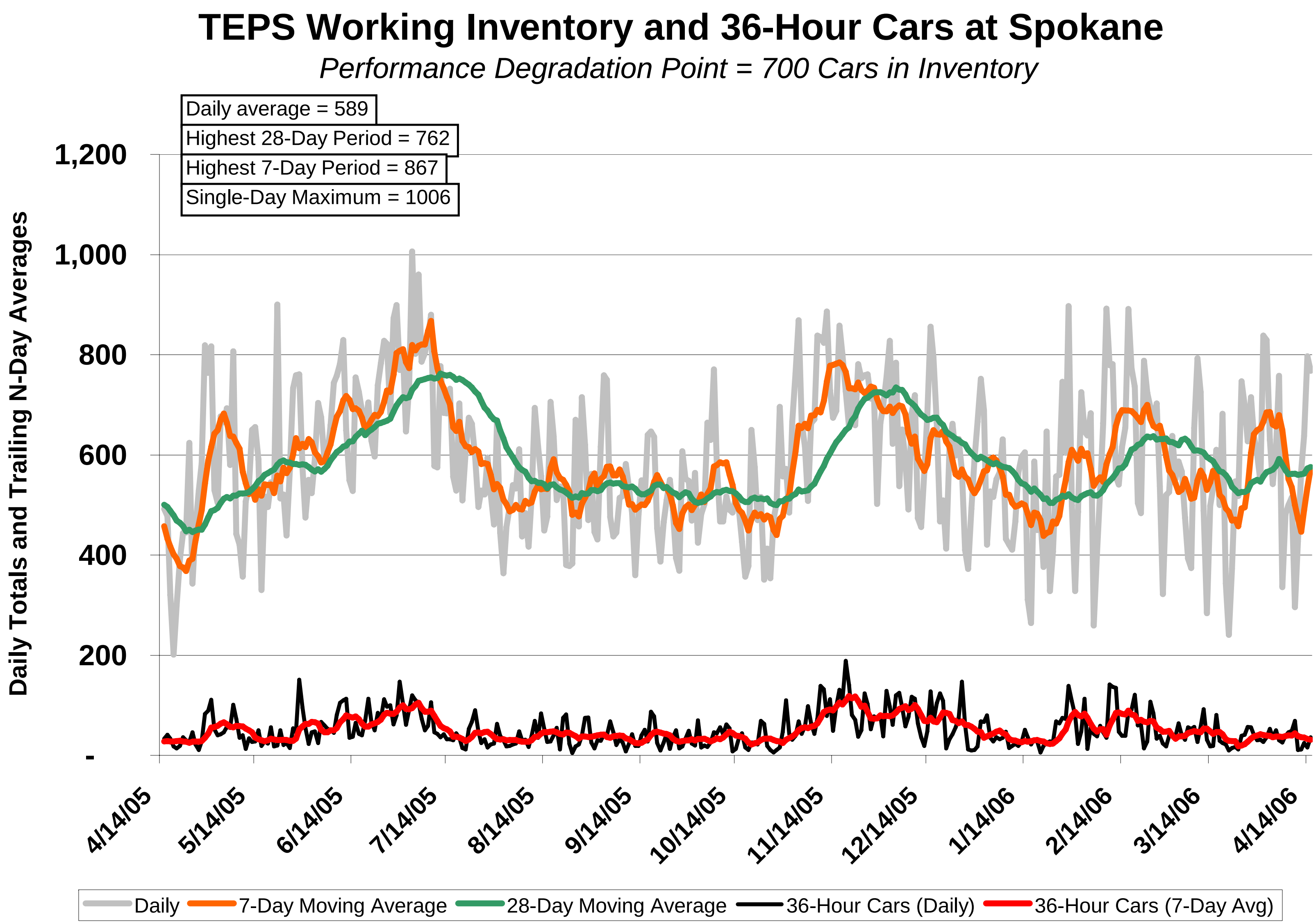
36-Hour Cars (7-Day Avg)


TEPS Working Inventory and 36-Hour Cars at Spokane
Performance Degradation Point = 700 Cars in Inventory
Daily average = 589
Highest 28-Day Period = 762
Highest 7-Day Period = 867
Single-Day Maximum = 1006
Daily Totals and Trailing N-Day Averages
1,200
1,000
800
600
400
200
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
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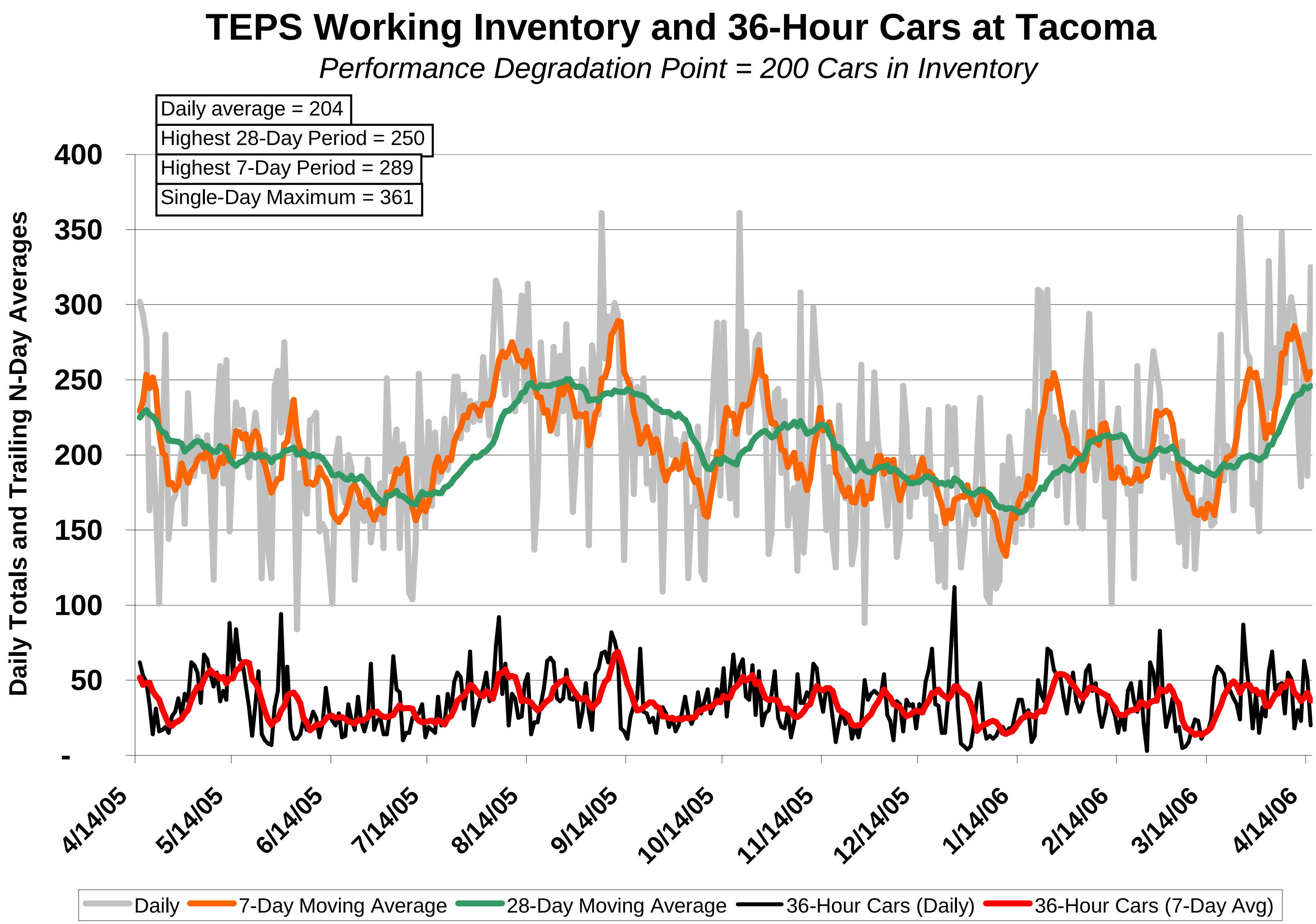
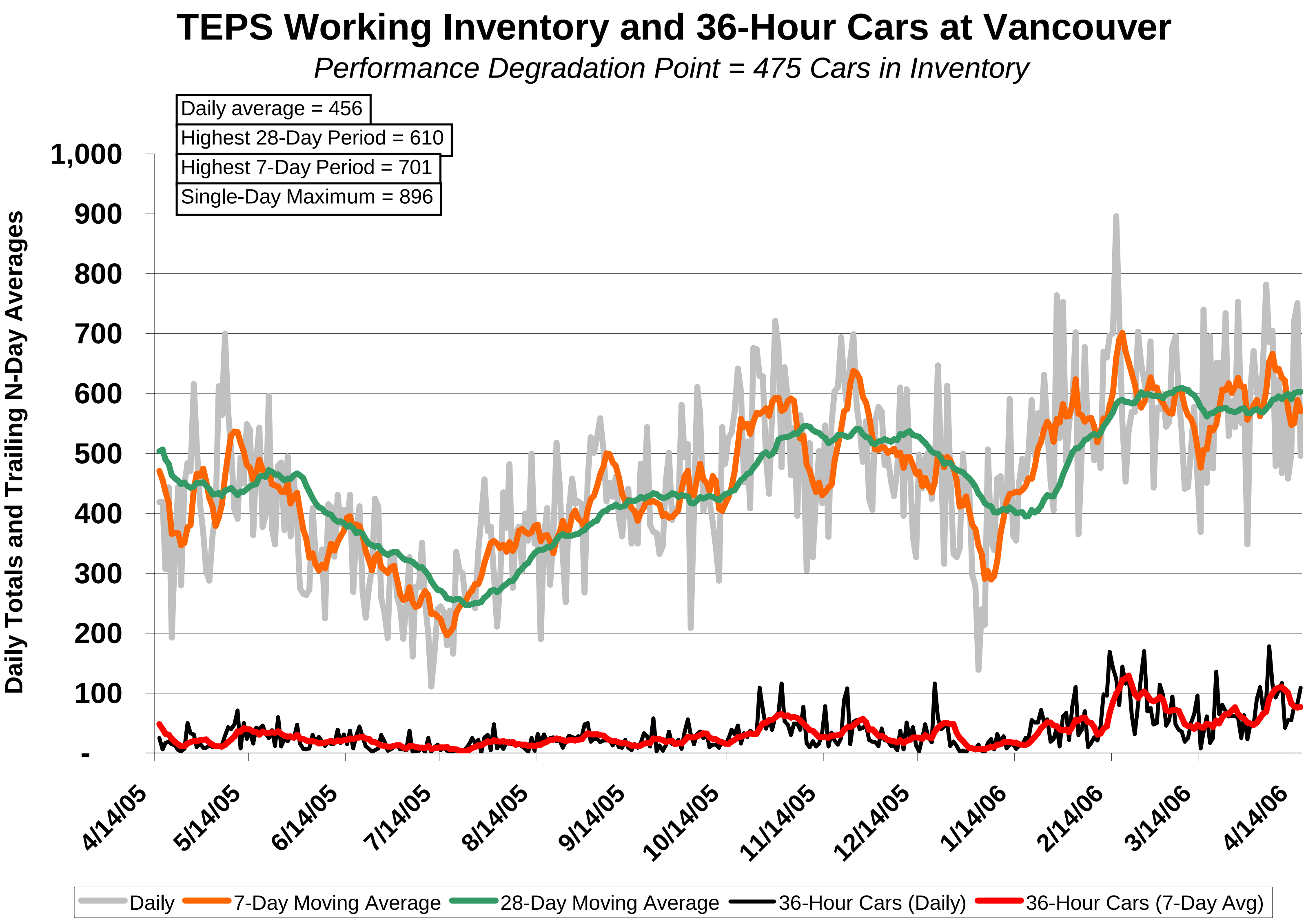
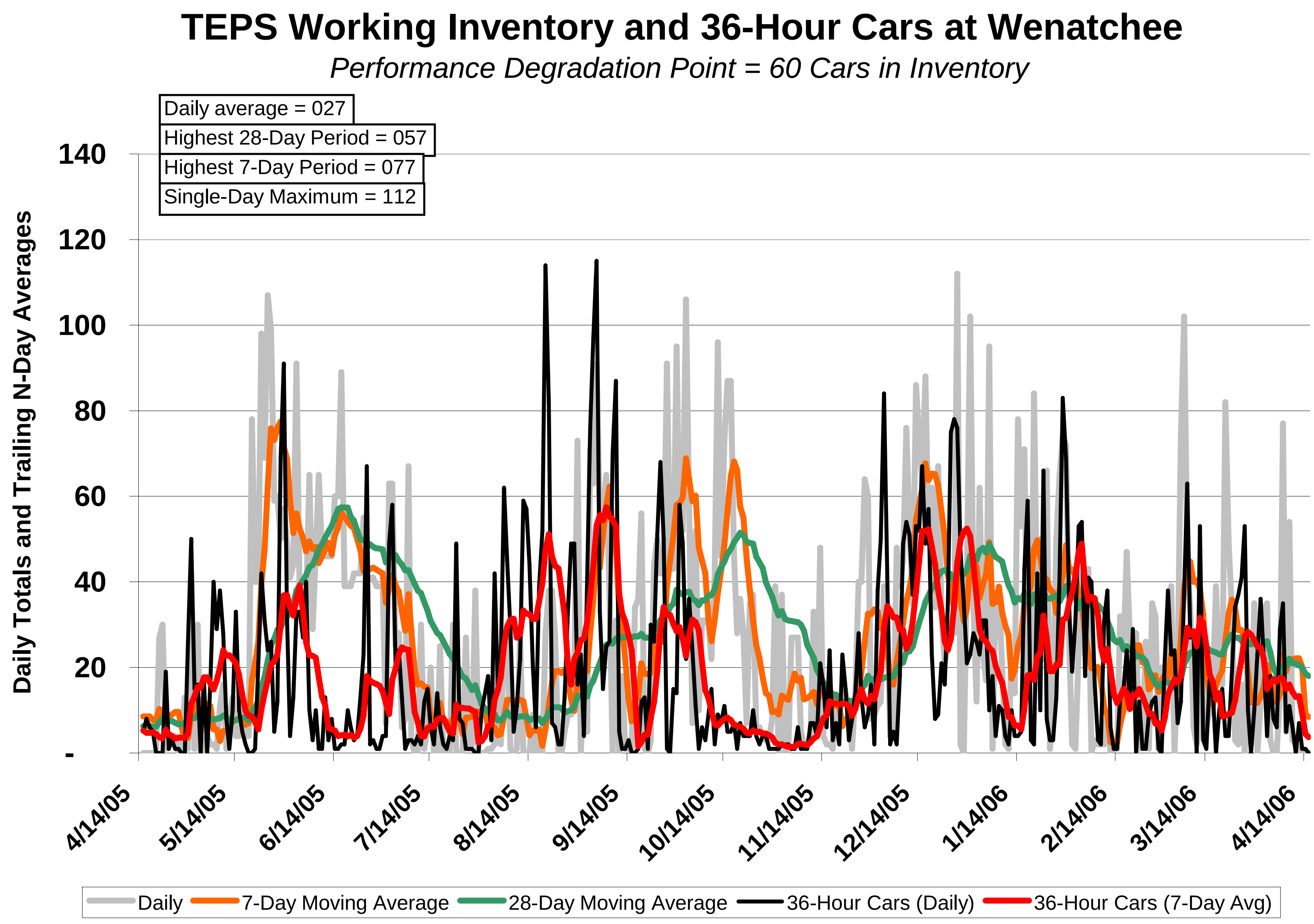
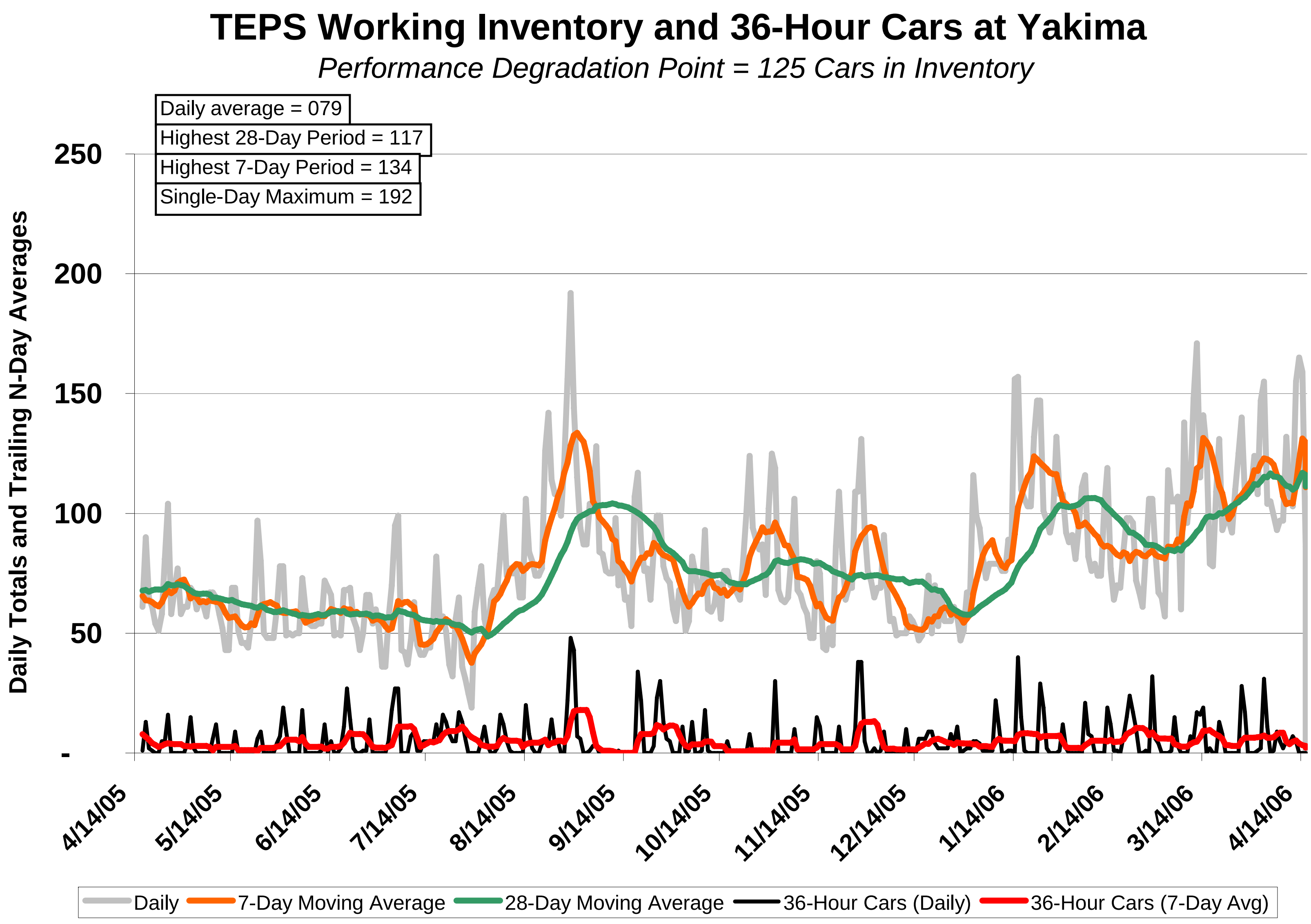
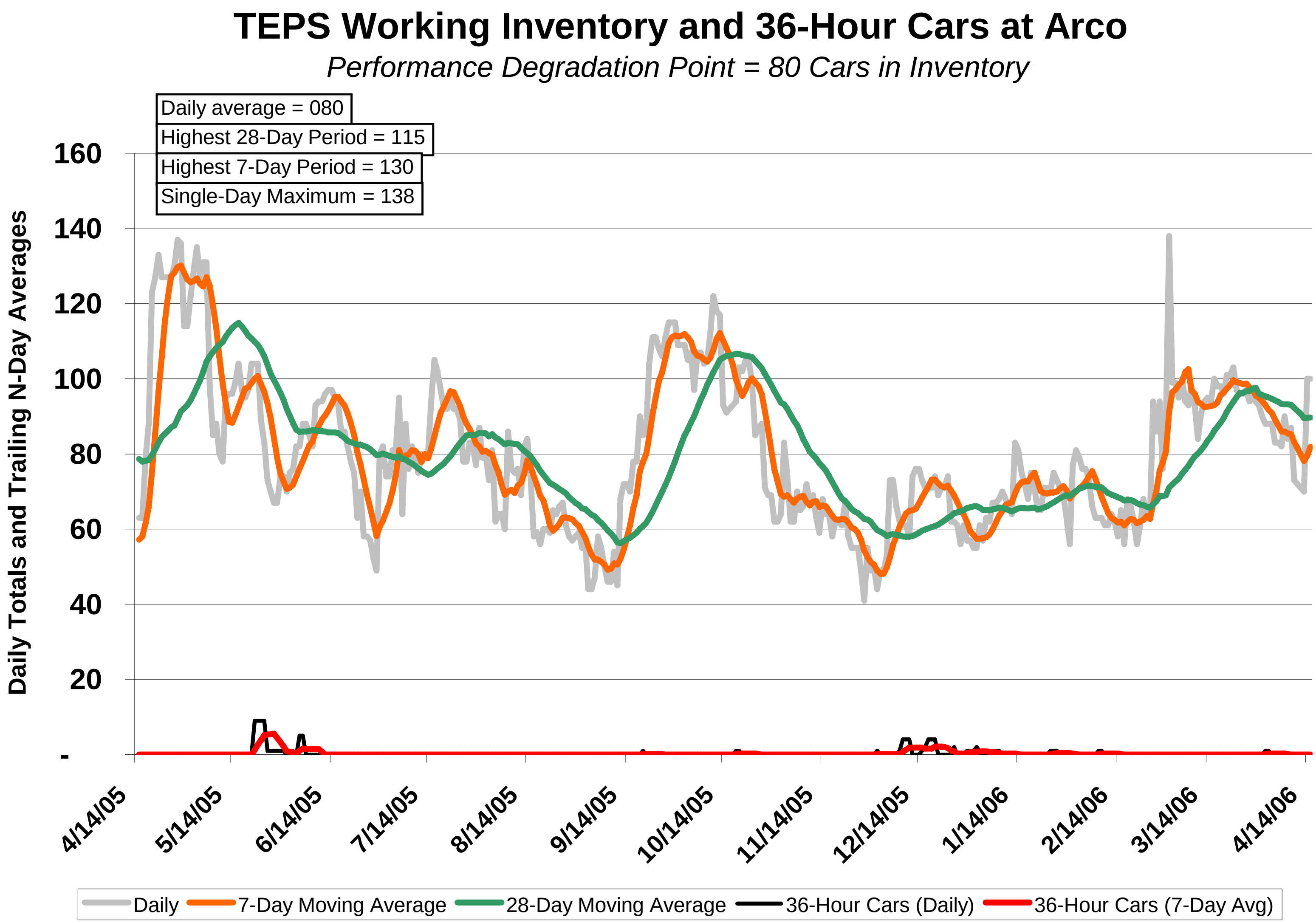
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)

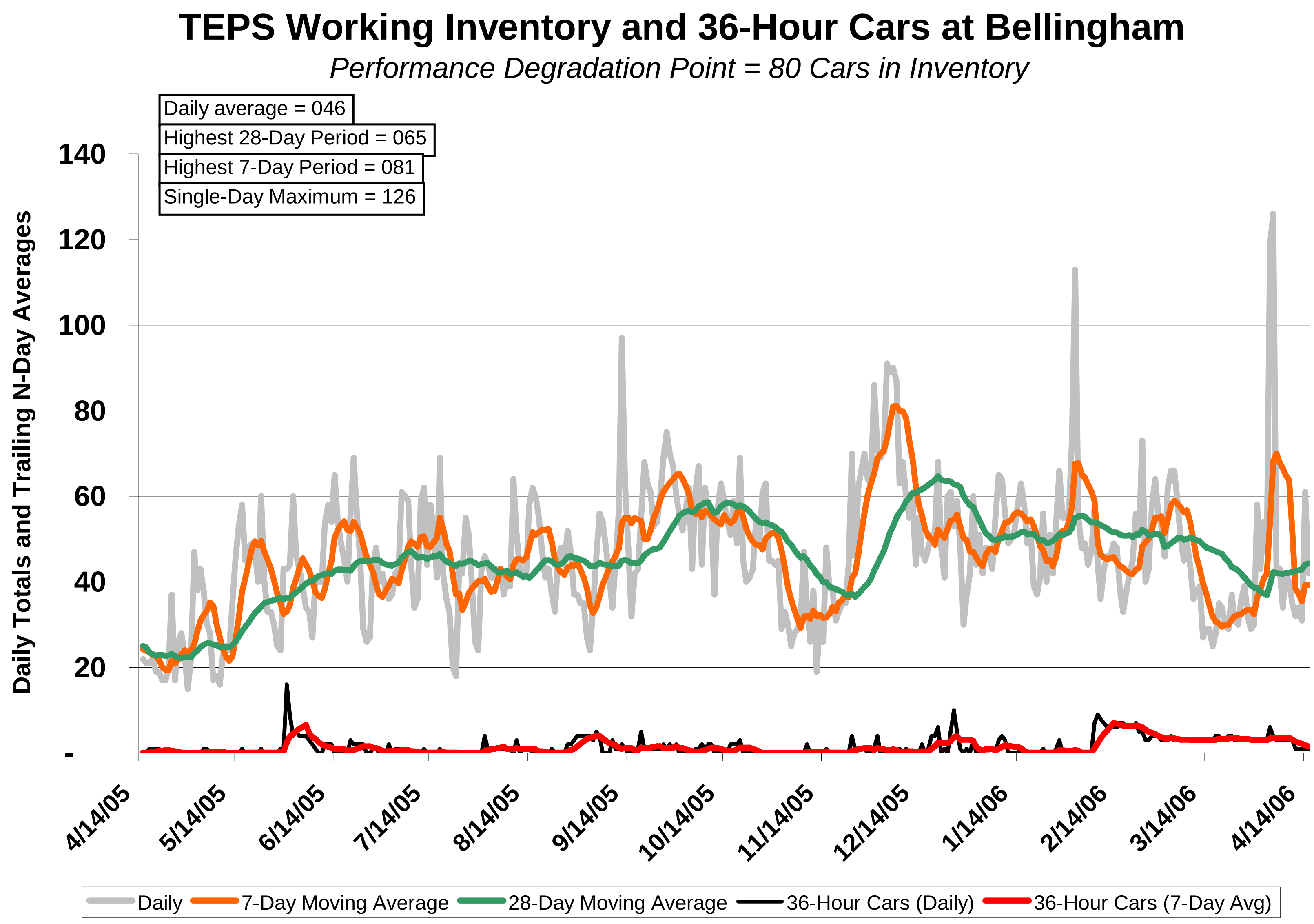

TEPS Working Inventory and 36-Hour Cars at Tacoma
Performance Degradation Point = 200 Cars in Inventory
Daily average = 204
Highest 28-Day Period = 250
Highest 7-Day Period = 289
Single-Day Maximum = 361
Daily Totals and Trailing N-Day Averages
400
350
300
250
200
150
100
50
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)

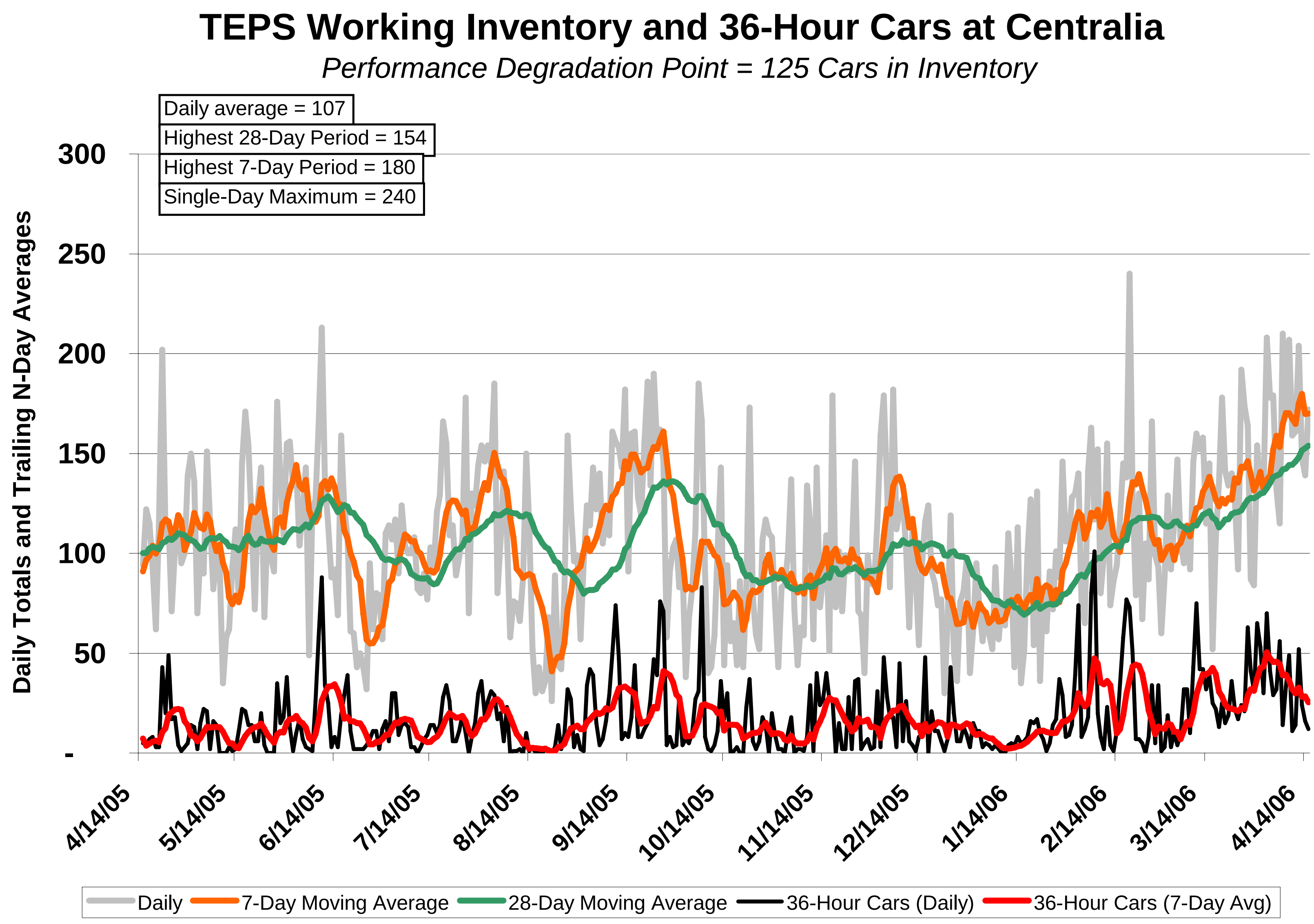

TEPS Working Inventory and 36-Hour Cars at Vancouver
Performance Degradation Point = 475 Cars in Inventory
Daily average = 456
Highest 28-Day Period = 610
Highest 7-Day Period = 701
Single-Day Maximum = 896
Daily Totals and Trailing N-Day Averages
1,000
900
800
700
600
500
400
300
200
100
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)

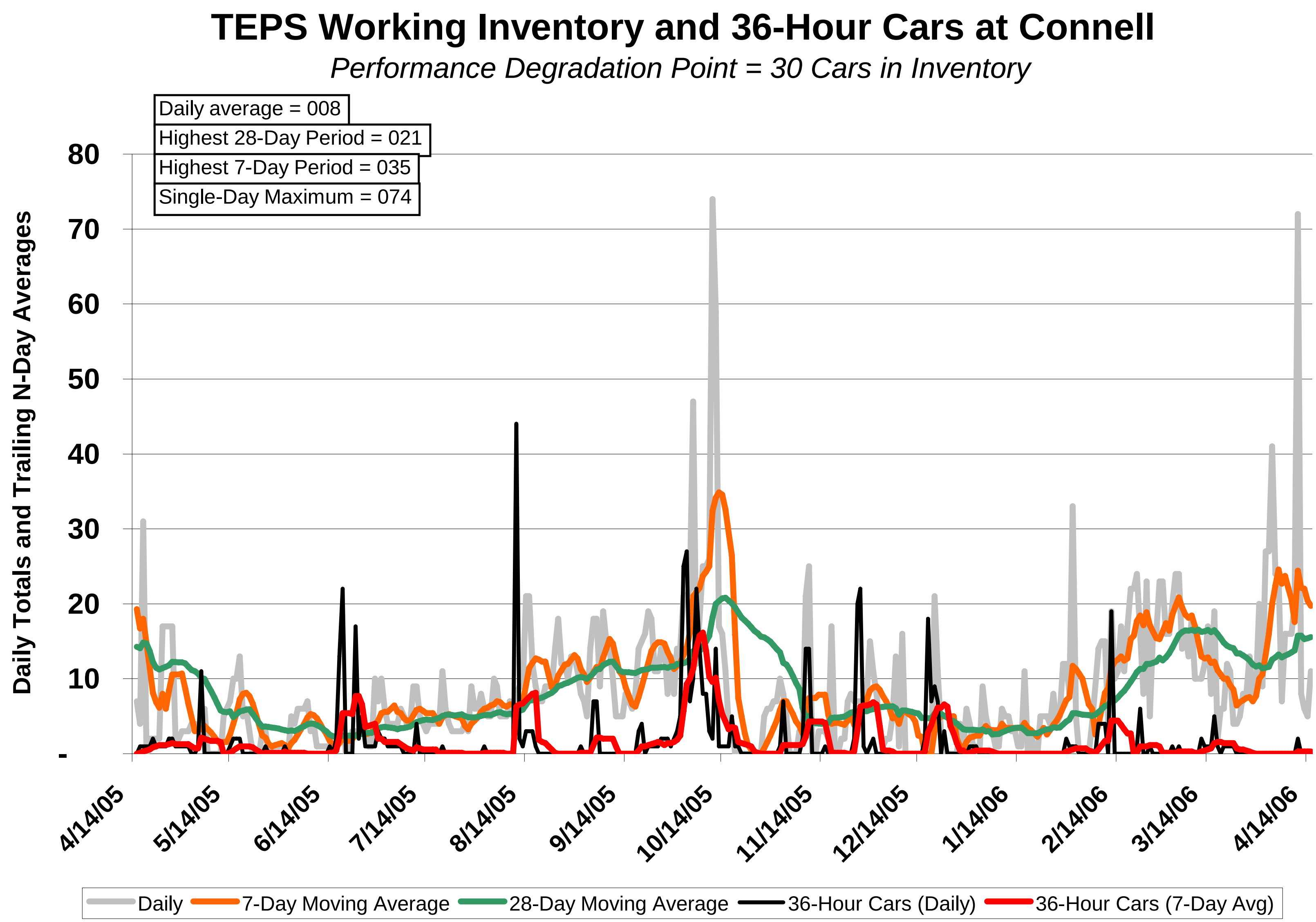

TEPS Working Inventory and 36-Hour Cars at Wenatchee
Performance Degradation Point = 60 Cars in Inventory
Daily average = 027
Highest 28-Day Period = 057
Highest 7-Day Period = 077
Single-Day Maximum = 112
Daily Totals and Trailing N-Day Averages
140
120
100
80
60
40
20
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)

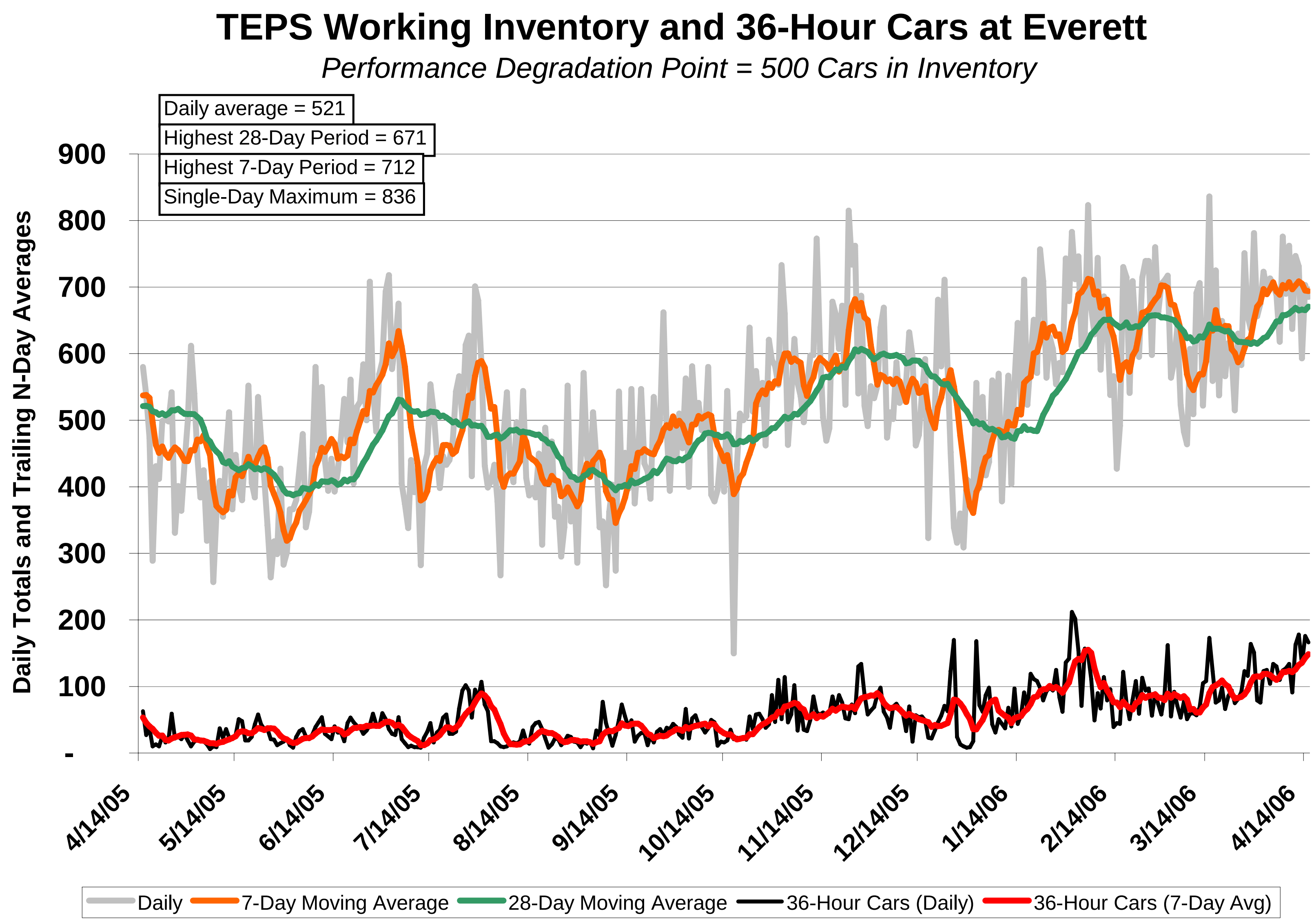

TEPS Working Inventory and 36-Hour Cars at Yakima
Performance Degradation Point = 125 Cars in Inventory
Daily average = 079
Highest 28-Day Period = 117
Highest 7-Day Period = 134
Single-Day Maximum = 192
Daily Totals and Trailing N-Day Averages
250
200
150
100
50
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)

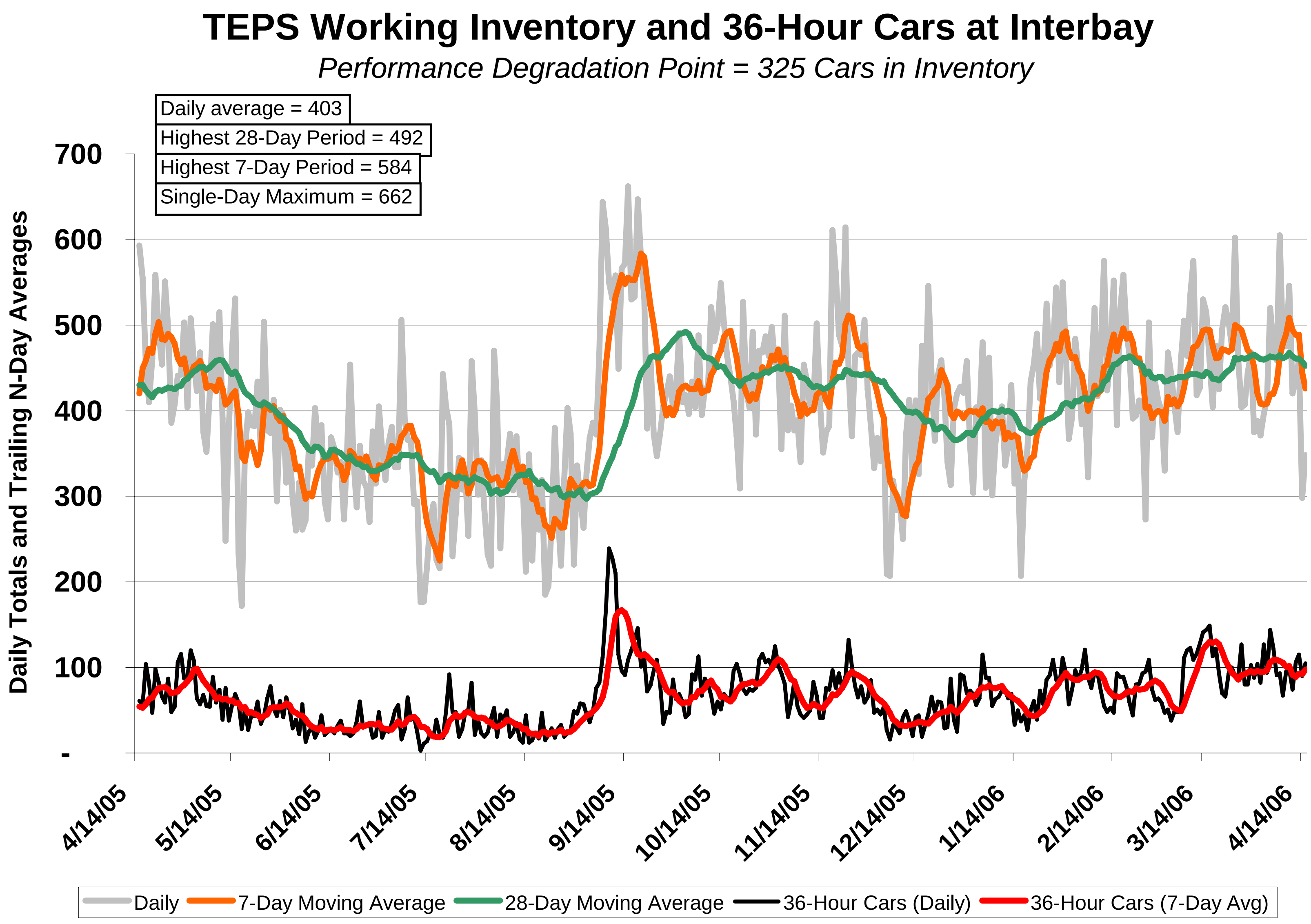

TEPS Working Inventory and 36-Hour Cars at Arco
Performance Degradation Point = 80 Cars in Inventory
Daily average = 080
Highest 28-Day Period = 115
Highest 7-Day Period = 130
Single-Day Maximum = 138
Daily Totals and Trailing N-Day Averages
160
140
120
100
80
60
40
20
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)


TEPS Working Inventory and 36-Hour Cars at Bellingham
Performance Degradation Point = 80 Cars in Inventory
Daily average = 046
Highest 28-Day Period = 065
Highest 7-Day Period = 081
Single-Day Maximum = 126
Daily Totals and Trailing N-Day Averages
140
120
100
80
60
40
20
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)


TEPS Working Inventory and 36-Hour Cars at Centralia
Performance Degradation Point = 125 Cars in Inventory
Daily average = 107
Highest 28-Day Period = 154
Highest 7-Day Period = 180
Single-Day Maximum = 240
Daily Totals and Trailing N-Day Averages
300
250
200
150
100
50
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)


TEPS Working Inventory and 36-Hour Cars at Connell
Performance Degradation Point = 30 Cars in Inventory
Daily average = 008
Highest 28-Day Period = 021
Highest 7-Day Period = 035
Single-Day Maximum = 074
Daily Totals and Trailing N-Day Averages
80
70
60
50
40
30
20
10
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)


TEPS Working Inventory and 36-Hour Cars at Everett
Performance Degradation Point = 500 Cars in Inventory
Daily average = 521
Highest 28-Day Period = 671
Highest 7-Day Period = 712
Single-Day Maximum = 836
Daily Totals and Trailing N-Day Averages
900
800
700
600
500
400
300
200
100
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)


TEPS Working Inventory and 36-Hour Cars at Interbay
Performance Degradation Point = 325 Cars in Inventory
Daily average = 403
Highest 28-Day Period = 492
Highest 7-Day Period = 584
Single-Day Maximum = 662
Daily Totals and Trailing N-Day Averages
700
600
500
400
300
200
100
-
4/14/05
5/14/05
6/14/05
7/14/05
8/14/05
9/14/05
10/14/05
11/14/05
12/14/05
1/14/06
2/14/06
3/14/06
4/14/06
Daily
7-Day Moving Average
28-Day Moving Average
36-Hour Cars (Daily)
36-Hour Cars (7-Day Avg)